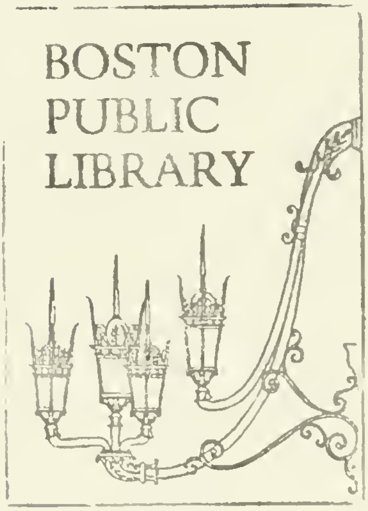

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SHRINERS BURNS INSTITUTE REPLACEMENT FACILITY PROJECT

FINAL PROJECT IMPACT REPORT

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SHRINERS HOSPITALS FOR CRIPPLED CHILDREN
51 Blossom Street
Boston, MA 02114

Prepared By:

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ENGINEERS, ENVIRONMENTAL CONSULTANTS & PLANNERS
A Summit Environmental Group Company

SHRINERS BURNS INSTITUTE
REPLACEMENT FACILITY PROJECT
BOSTON, MASSACHUSETTS

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I. Executive Summary

I. EXECUTIVE SUMMARY

1.0 INTRODUCTION / ENVIRONMENTAL STATUS

The proposed Shriners Burns Institute is a 200,000 square foot Replacement Facility for the existing Burns Institute in Boston, Massachusetts. The facility includes 30 patient beds and related patient care and out-patient treatment facilities, and 30,000 square feet of research space. Below-grade parking of 100 spaces (previously proposed 150 spaces) is currently being negotiated.

The project involves construction of the new facility above the existing, while keeping the existing facility in full operation. Upon completion of the new facility, the existing building below will be demolished and replaced with administration, materials management, medical research space and below-grade parking.

On March 14, 1991, the Shriners Hospital for Crippled Children submitted a Project Notification Form (PNF) to the Boston Redevelopment Authority (BRA) presenting its plans to construct a Replacement Facility at the site of the existing Shriners Burns Institute at 51 Blossom Street in the West End Urban Renewal Area of the City of Boston. On May 23, 1991 a BRA public meeting was held at Shriners. On June 23, 1991, the BRA, in response to the PNF, issued a Scoping Determination (see Section I-4.1) pursuant to Article 31, Development Review Requirements requiring the submission of a satisfactory Project Impact Report.

The Scope referenced in Section VI of the BRA Scoping Determination included the following major components: general information, transportation, environmental protection, urban design, historic resources, and infrastructure systems.

On May 1, 1991, Shriners submitted an Environmental Notification Form (ENF) to the Commonwealth of Massachusetts' Executive Office of Environmental Affairs pursuant to the Massachusetts Environmental Policy Act (MEPA). The ENF was publicly noticed in the Environmental Monitor on May 8, 1991. A MEPA Scoping Session was held at the hospital on May 28, 1991. The Certificate of the Secretary on the ENF was issued on June 21, 1991 requiring the preparation of an Environmental Impact Report. MEPA stipulated that the format of the EIR was to be determined by the requirements of the City's Article 31 review and that the scope established by the BRA could serve as the scope for the EIR provided that substantive responses to the comments submitted on the ENF and those included in the June 21, 1991 Certificate be addressed in the document. MEPA also stipulated that in addition to Article 31 distribution requirements, distribution should be in accordance with MEPA Regulations in 301 CMR 11.24 and copies should also be distributed to St. Joseph's Church, Massachusetts Historical Commission, Rappaport and Rakov and Widett, and to Hawthorne Place Condominium Trust.

On October 30, 1992, Shriners submitted a Draft Environmental Impact and Draft Project Impact Report (DEIR/DPIR) to the Commonwealth's Executive Office of Environmental Affairs and to the Boston Redevelopment Authority. The DEIR was noted in the Environmental Monitor on November 5, 1992. A Certificate of the Secretary on the DEIR was issued on December 12, 1992 stating that the DEIR adequately and properly complied with the Massachusetts Environmental Policy Act (G.L. c. 30, S. 61-64) and with its implementing regulations (301 CMR 11.00). The Secretary directed the proponent to address all comments on the DEIR, provide information on mitigation, and meet with the Boston Redevelopment Authority, and the Boston Transportation Department in addressing mitigation within the FEIR (see Appendix A).

On February 15, 1992, Shriners submitted a Final Environmental Impact Report (FEIR) to the Commonwealth's Executive Office of Environmental Affairs. The FEIR was noticed in the Environmental Monitor on February 26, 1992. While the project proponent filed a joint DEIR/DPIR, the FEIR was submitted while awaiting the BRA's determination on the DPIR.

The Certificate of the Secretary on the FEIR was issued on April 3, 1992 stating that the FEIR adequately and properly complied with the Massachusetts Environmental Policy Act (G.L. c.30, s. 61-62H) and with its implementing regulations (301 CMR 11.00). The secretary also directed the proponent to address the issues raised by the BRA (see Section IX-1.0) and to resolve them before the Article 31 process is completed.

The Boston Redevelopment Authority issued a Preliminary Adequacy Determination (P.A.D.) on the Draft Project Impact Report (DPIR) on April 23, 1992 (see Section I-4.2). The P.A.D requested additional information required by the BRA for its review pursuant to Article 31 of the Boston Zoning Code. The BRA determined that "but for the required corrections, clarifications and additional information referenced in the Technical Appendix (to the letter), the DPIR submitted is sufficient to satisfy the scoping requirements".

2.0 CHANGES TO THE PROJECT AND BRIEF PROJECT DESCRIPTION

2.1 Changes to the Project Since the DEIR/DPIR and FEIR

The Shriners has continued to meet with the Boston Redevelopment Authority, Boston Transportation Department, the MEPA office and representatives from the neighborhood to make modifications which will improve the project's local acceptance. As pointed out in the DEIR/DPIR, a number of major design modifications were made between the time of the Project Notification Form (PNF) and the DEIR/DPIR (see DEIR/DPIR, Section III). Since the DEIR/DPIR and FEIR submissions, the Shriners have been negotiating the reduction in total on-site parking from 133 spaces in the FEIR to 100 spaces. In addition, a ground level landscaping plan has been more fully developed to utilize further increased building setbacks from Blossom Street and William Cardinal O'Connell Way. Through BRA's design review process and architectural input from the Boston Civic Design Commission, the Boston Zoning Commission and the Hawthorne Place Condominium Trust, a number of modifications have resulted in the project design. The trellis and garden have been removed from the roof to reduce the overall height of the project from 148 feet to 137 feet. The Shriners have also restudied the design and added a canopy at the two entrances. In addition, a cornice at the third floor extends over the first floor arcades proposed along portions of William Cardinal O'Connell Way and Blossom Street which will reduce the impact of the building's massing at the pedestrian level. A cornice has also been added at the 9th floor to screen the upper level and visually reduce the building height.

As a result of recent discussions in June, 1992 with staff of the BRA, members of the Zoning Commission and representatives from the Hawthorne Place Condominium Trust, additional design changes have resulted including: deletion of stair projection on roof; reduced height of the patient elevator penthouse by ten feet; setback of glass corner by five feet at the intersection of William Cardinal O'Connell Way and Blossom Street; and consideration of alternative landscape treatment options relating to changes in the amount of paved area vs. ground cover. The project proponent feels that these changes will improve the design based on the input from neighborhood group discussions. In addition, these modifications will be further refined during the remainder of the BRA design review process.

2.2 Brief Project Description

The Shriners Burns Institute Replacement Facility is proposed to be located on the existing Burns Institute site. The block is bounded on the north by William Cardinal O'Connell Way and on the west by Blossom Street. Adjacent facilities include St. Joseph's Catholic Church and Regina Cleri (elderly priest's housing) to the east, the Blackstone Apartments (elderly housing) to the south, Charles River Park (high rise residential building) to the north, and Massachusetts General Hospital to the west. The facilities of Massachusetts General Hospital directly across Blossom Street include the Wellman Research Building, the Edwards Research Building and Bartlett Hall (see Figure I-2.1).

The proposed Shriners Burns Institute Replacement Facility will replace the existing hospital facility built in the late 1960's. The number of patient beds will remain at the present 30, and staffing and researchers will increase by 62 to approximately 332 employees and researchers. The Replacement Facility will continue the functions now taking place in the existing facility, e.g. surgery, out-patient care, physical therapy and medical research, and provide adequate space for the expanded requirements of new technologies and equipment, and outpatient care and support functions. Approximately 23,000 square feet of research space, which is currently being moved off-site, will be returned to the new facility upon completion. About 3,600 square feet of business and administrative space currently off-campus will also return to the new facility. (The administrative and medical research space are being placed off-site in preparation for the phased reconstruction and because of space constraints in the existing building.) The total program area will then increase from approximately 83,600 square feet* to approximately 200,000 gross square feet, with an additional 70,000 gross square feet provided in a 2½ story, below-grade parking garage. These new facilities will provide state-of-the-art patient care, research and teaching to carry forward the purposes of the Shriners Burns Institute. Major uses of the facility include 30 patient beds, surgery, outpatient care, therapy, parent facilities, auditorium and research. A more detailed breakdown of the building program is included in Section III, Updated Project Description and Alternatives to the Project.

Building on the existing site will be accomplished in two phases. Phase I involves construction of a series of steel trusses over the existing building, which will support four levels above. Normal operations will be maintained in the existing facility while

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* Includes 80,000 square feet in existing building plus 3,600 square feet in currently off-site space used for business and administrative uses.

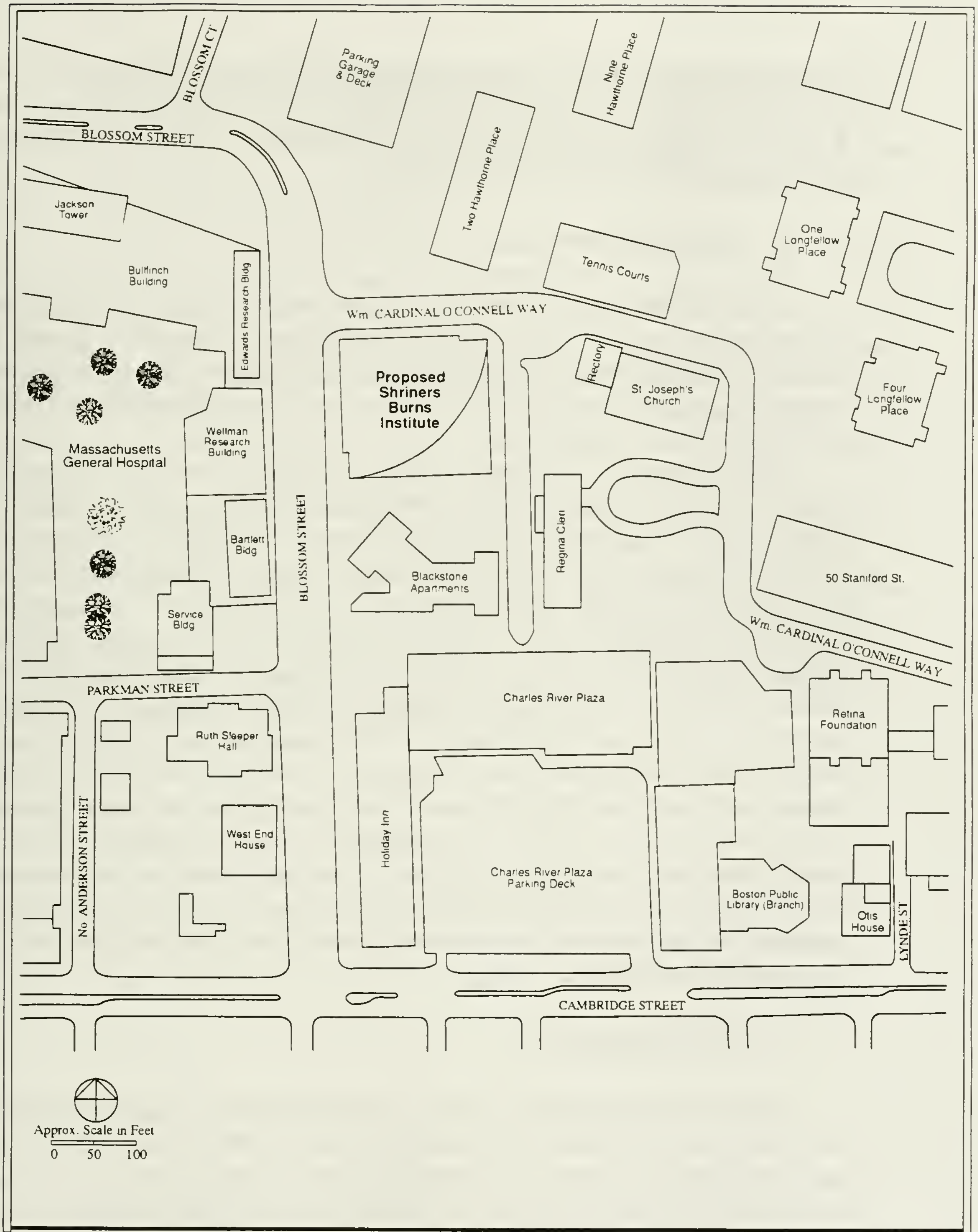

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FIGURE I-2.1
SITE LOCATION
Shriners Burns Institute

construction above is underway. Upon completion of Phase I, patients and staff will move into the new facilities on the upper levels. Phase II will then begin, including demolition of the existing facility and construction below the truss of four levels of hospital functions, and two and a half levels of below-grade parking.

2.3 Project Alternatives

After exploring alternate sites, the Shriners determined that building on their existing site was the best option. It allows the hospital to maintain its physical link (through an existing tunnel) with Massachusetts General Hospital, which permits the rapid movement of patients between the two hospitals to provide specialized treatment facilities as needed to patients at both hospitals.

Project alternatives have been evaluated by Shriners over the last three years including extensive discussions with Massachusetts General Hospital (MGH) on an appropriate relocation site for a new, enlarged permanent facility as well as identification of temporary space to allow the Shriners to reconstruct a new facility on Blossom Street's existing Burns Institute site. Shriners examined sites on Nashua Street, next to Spaulding Rehabilitation Hospital, at the Charles Street Jail, and on Lomasney Way before concluding that its current site was preferrable in terms of competing land uses and proximity to MGH. In addition, documentation of MGH's inability to provide interim space during construction is contained in a MGH response letter to Dr. Salvatore P. Russo, Shriners' Administrator (see Appendix A). Therefore, the proposed building program must insure that existing functions at the Burns Institute continue uninterrupted during reconstruction. This will be accomplished by the truss's construction over the existing building and construction of the Phase I upper levels initially for the Replacement Facility. Following this, the existing program will be relocated to the newly built space, the old hospital will be demolished, and the Phase II construction will be completed below the truss, including the below-grade parking.

2.4 Design Modifications

After evaluating various designs for the proposed facility, the design submitted to the BRA in the Project Notification Form (PNF) on March 14, 1991, described a 200,000 gross square foot project with above-grade parking for 150 cars. Five levels were to be built above the truss (155,000 gross square feet in Phase I), and two levels of hospital functions (45,000 gross square feet) and parking levels (above-grade) would follow in Phase II.

As originally proposed, the building height was 155 feet, the maximum permissible in the IPOD District. A roof terrace/play area was proposed on the southeast corner of Level 10. An automobile drop-off was planned along William Cardinal O'Connell Way, as were the entrances and exits from the parking levels and the service entrance, making use of an existing easement with the Archdiocese.

A series of neighborhood meetings following the PNF submittal led to major modifications and the resulting design of the DEIR/DPIR scheme. The FPIR project continues to propose the DEIR/DPIR's nine-story structure with 2½ levels of below-grade parking although the Shriners have been negotiating a decrease in the number of parking spaces from 133 to 100. Four levels will be built above the truss level and four below the truss level. Mechanical equipment is housed at the truss level. The building height of 137 feet (reduced from 155 feet in the PNF) is approximately the same height as MGH's Wellman Research Building, located across Blossom Street. The lowered height improves specific views from adjacent buildings. The parking entrance/exit has continued to be relocated to Blossom Street and away from the nearby St. Joseph's Rectory as requested in discussions with the neighbors. The building footprint has been reduced, now providing full front yard setbacks and mitigating the impact from the mass and creating wider green spaces between the new building and the street. Section III provides more detail on the various alternatives considered before the PNF design, as well as subsequent modifications made to the design based on community concerns and input.

3.0 SUMMARY OF ENVIRONMENTAL EFFECTS OF THE PROJECT

A number of issues were examined and presented in the DEIR/DPIR submittal. Additional studies required to respond to the Secretary of Environmental Affairs' Certificate on the DEIR have been conducted. Provided below are summaries of all studies conducted for both the DEIR/DPIR and this FPIR.

3.1 Transportation

The addition of project-generated traffic will not noticeably affect operations at any of the study intersections during either the morning or afternoon peak hours. Levels of Service (LOS) will remain the same for the No-Build and Build conditions given the small increases in peak hour traffic.

The most critical transportation issue facing the project is parking for patient visitors and outpatients. Currently the Shriners Burns Institute maintains a total of 127 parking spaces for employees, volunteers and Board members. However only three of these spaces are located on-site. An analysis of patient and family members indicates that over 2/3 of outpatients and visitor trips are made by automobile. However, no parking spaces are provided for these users.

After redesign in June 1991, the proponent intended to construct a 150-space below-grade garage while maintaining all 124 off-site spaces, for a total of 274 spaces. The analysis of future conditions presented in the FPIR includes new data on auditorium usage and demonstrates a parking demand for 343 spaces. Nonetheless, the on-site parking capacity of the proposed underground garage has been reduced. The Shriners have been negotiating for a reduction of on-site spaces to 100 spaces.

Based on the modal splits assumed for the project, it is anticipated that 21 of the new employees will use public transportation to and from work on a daily basis, while nine of the outpatients, along with accompanying family members also will use public transportation. Most of these new trips will be made during off-peak hours, when the public transportation system can readily accommodate these minor increases.

In an effort to reduce the number of vehicles driving to the site, the Institute will enter into an agreement with the Massachusetts General Hospital to participate in their computerized ridesharing/vanpooling programs.

Service vehicle traffic is not expected to increase for the new facility because the increase in deliveries and removals can be accommodated by the current schedules and modalities.

3.2 Wind

A qualitative assessment of pedestrian level winds was conducted for the DEIR/DPIR to find the effect of replacing the four-story existing Shriners Burns Institute with a nine-story Replacement Facility. The assessment was based on local wind conditions and building heights of the existing and proposed facility as well as the surrounding building heights (see Figure I-3.1). No location on the site is currently believed to have winds that are excessive or exceed the BRA guideline effective gust wind speed of 31 mph once per 100 hours. The addition of the Replacement Facility is not expected to cause the guideline wind speed to be exceeded.

Five categories of pedestrian level wind speeds have been defined using the Melbourne* probabilistic criteria. These categories are as follows:

Melbourne Category 1:	Dangerous and Unacceptable.
Melbourne Category 2:	Uncomfortable for Walking.
Melbourne Category 3:	Comfortable for Walking.
Melbourne Category 4:	Comfortable for Short Periods of Standing or Sitting.
Melbourne Category 5:	Comfortable for Long Periods of Standing or Sitting.

The potential impacts of the project were predicted using these criteria as well as the BRA guideline of 31 mph.

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* Melbourne, W. H., 'Criteria for Environmental Wind Conditions', Journal of Industrial Aerodynamics, Vol, 3, 1978, pp. 241-249.

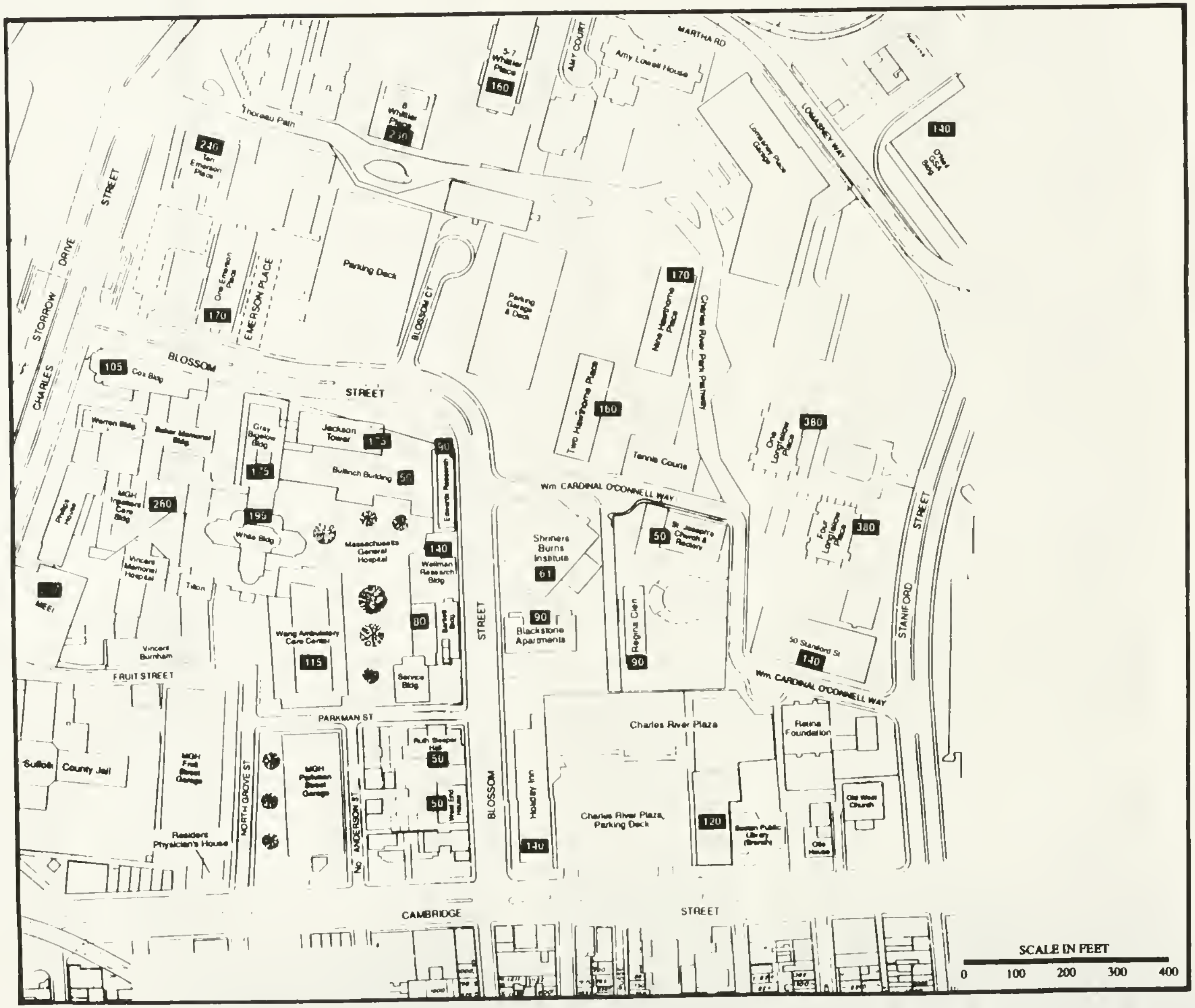

FIGURE I-3.1
PROJECT AREA SHOWING BUILDING HEIGHTS*

LEGEND

■ Building Height

* Heights shown are top elevations above grade and are approximate.

hm
hm

Mitigation of Winds During Construction

Concern was expressed over winds produced during the truss construction and subsequent demolition and construction of the Phase II lower levels of the facility. Little difference is expected from project impacts already discussed, with initial construction of the project's upper portion. Once the upper portion is completed and the lower portion removed, the typical practice is to enclose the construction area with a fabric sheeting material. This fabric material contains small holes for ventilation and also mitigates construction impacts beyond the site. The openings of this sheeting material are less than 50% of total area. Winds should therefore be restricted from flowing unimpeded below the upper portion of the project, once demolition of the existing structure occurs. Further, because some wind will be able to flow through the construction area, winds around building corners will also be diffused.

3.3 Shadows

Minimal new shadow impacts associated with the Replacement Facility can be expected during the warmer time periods (Spring, Summer, and Fall) in the morning and at noon. Later in the day, at 3:00 PM during the Spring, some new shadows occur from the new building. However, some additional sunlight will be brought into the open area between St. Joseph's Church and Regina Cleri due to the rounded design of the upper floors of the new building. During the winter condition, the project adds new shadow further away from the project, however, the immediate area is already heavily shadowed.

Further analysis of shadow impacts during the Vernal Equinox on the vegetation by Two Hawthorne Place and St. Joseph's Church was requested. This new analysis was completed and included in Section V-2 of this FPIR. The overall increase in shade from two to four hours a day in limited areas (ranging in size from 1,000 sf to no more than 2,800 sf), during the Vernal Equinox, should have little effect on the existing vegetation's productivity and development in the area of Two Hawthorne Place. The vegetation is primarily shade tolerant. During the month of March, most of the plant species are still dormant or are just beginning to emerge from dormancy. In spite of the intervals of new shade, indirect light from reflection off adjacent buildings will be available to the vegetation during these periods. As a result, negative impacts to the growth of the vegetation in front of Two Hawthorne Place from the short increases in shade from the Replacement Facility are not expected.

The various shrubs identified along the west face of the Rectory are all shade tolerant. During the Vernal Equinox at 3:00 PM, the St. Joseph's Rectory is covered by shadow emanating from the existing Shriners Building. The existing shadows are visible approximately 15 feet vertically on the west face of the Rectory. New shadows from the proposed Replacement Facility will only extend further up the face of the Rectory. The width of the existing shadow will also be increased by approximately 30 feet. However, due to the configuration of the existing building, this increase will not affect the duration of shading. In fact, the new facility will reduce some of the existing shadow on the vegetation between the Rectory and the Regina Cleri. The vegetation will therefore not be subjected to any additional shade by the proposed Replacement Facility overall.

Additional shadow studies were also completed for a hypothetical project massing scheme one floor lower for the Vernal Equinox (March 21) at 12:00 noon and 3:00 PM and for the Winter Solstice (December 21) at 3:00 PM when shadows are at their longest. Net change in impact is minimal during these time periods.

3.4 Daylight

A daylight analysis was conducted for the DEIR/DPIR in response to the BRA scope to estimate the extent to which the proposed Shriners Burns Institute affects the amount of daylight reaching the street level. The daylight study was performed utilizing the BRA Daylighting Analysis (BRADA)* computer software.

In the DEIR/DPIR, two viewpoints were chosen to evaluate daylight obstruction for the existing and proposed Shriners Burns Institute. The viewpoint locations were centered on the middle of the north and west sides of the proposed building and the centerline of the adjacent streets (Blossom Street and William Cardinal O'Connell Way). One additional viewpoint has been analyzed for the FPIR along the path between St. Joseph's Church and Regina Cleri (see Figure I-3.2). The results of the daylight analysis are presented below.

The daylight obstruction results are primarily due to the orientation and height of the proposed building and are not unlike other urban areas within Boston. In all cases examined, the angle created by the viewpoint and the edges of the width of view are less than a normal person's angle of peripheral vision. A person's vision would extend beyond the edge of the property boundary from the vantage points. Since the view in this analysis is cut off at the property edge, daylight which will be experienced beyond the property edge is not accounted for.

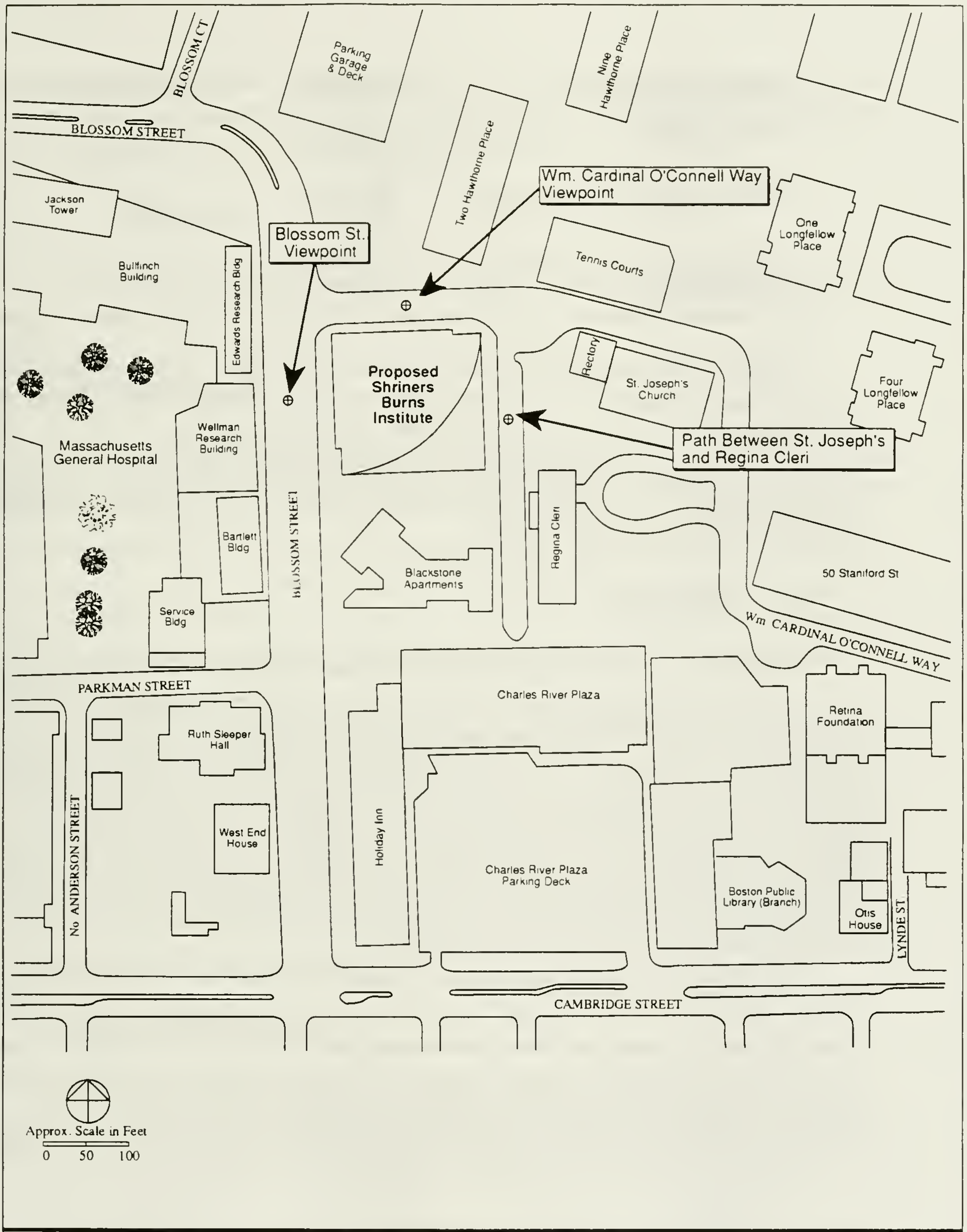

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FIGURE I-3.2
DAYLIGHT STUDY VIEWPOINT LOCATIONS

Viewpoint Locations	Condition	Percent Obstruction
Blossom Street	Existing	18.4
	Build	71.3
William Cardinal O'Connell Way	Existing	25.8
	Build	79.4
Path between St. Joseph's Church and Regina Cleri	Existing	36.8
	Build	52.1

Daylight impacts at the additional viewpoint at the rear of the building along the path between St. Joseph's Church and Regina Cleri are considerably less than the other two viewpoints studied in the DEIR/DPIR (Blossom Street and William Cardinal O'Connell Way). The new taller facility will obstruct only 15.3% more daylight than the existing building. This reduced impact is due in part to the curved design of the upper floors at the building's southeast corner.

3.5 Solar Glare

Potential for solar glare, and primarily spot glare, from the project's southeast facade was evaluated using solar altitude and azimuth angles and simple geometry. The analysis conducted for the DEIR/DPIR demonstrated that the spread of potential reflected light will generally be limited to the area southeast of the project; i.e., north of Cambridge Street, east of Blossom Street, and south of William Cardinal O'Connell Way. The project's southeast facade will be the largest contributor of reflected light, however, these effects will primarily be noticeable during only the early morning hours. In addition, the study indicated that there would not be any spot glare within the direct line of vision of any major roadway or at any roadway intersection.

The building materials will include a number of design features to mitigate these effects. First, the project will not use mirror coated, highly reflective glass which is generally found to cause the most intense occurrences of spot glare. Instead the project will use clear glass with a ceramic coating to limit the transmission of sunlight into the project building and reduce the intensity of reflected light. Also, the curve of the southeast facade will mitigate the effects of reflected light by scattering incoming parallel

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* Harvey Bryan and Susan Stuebing, "Boston Redevelopment Daylighting Analysis (BRADA)," MIT, Cambridge, MA.

rays of sunlight. The flat windows making up the curved surface will produce some reflected light, however, but the reflected light will consist only of narrow bands the width of the individual flat sections (about six and a half feet).

3.6 Air Quality

An air quality modeling analysis was conducted for the DEIR/DPIR to address possible impacts from the proposed Shriners Burns Institute project-generated traffic.

Intersection Analysis

The Cambridge Street/Staniford Street intersection was the only signalized intersection meeting the BRA and DEP criteria for air quality analysis (i.e., LOS D with 10% project-related growth or LOS E or F). The objective of the air quality analysis was to determine whether construction of the proposed Shriners Burns Institute will cause or increase any predicted exceedance of the Massachusetts and National Ambient Air Quality Standards (NAAQS) for carbon monoxide (CO). CO is used in this analysis as an indicator of roadway air pollution levels, since it is the most abundant pollutant emitted by motor vehicles.

The results of the air quality study indicate that because the proposed Shriners Burns Institute Replacement Facility generates little new traffic in relation to existing peak conditions, it has no impact on the maximum predicted CO concentrations. Each of the receptors studied show compliance with the one-hour NAAQS for the existing, future build and no-build uses. Although the eight-hour NAAQS is exceeded under existing conditions at one receptor, the exceedance is a result of conditions independent of the proposed Shriners Facility. Further, the project does not exacerbate this exceedance and is, therefore, in compliance with the NAAQS.

Garage Ventilation Analysis

An ambient air quality analysis for the 1994 build case was performed to determine the impacts of the proposed underground parking garage ventilation system. The analysis utilizes Volume 9 Guidelines* and MOBILE4 to generate emissions from the garage vents for the area peak traffic hour, the peak 8-hour period as well as the garage peak traffic hour, which occurs during midday.

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* EPA, Guidelines for Air Quality Maintenance Planning and Analysis, Volume 9 (Revised): Evaluating Indirect Sources, EPA-450/4-78-008.

Using emission data and current design characteristics for the ventilation system, concentrations of CO at the ventilation exhaust exits were determined. These concentrations were then used to determine ground level concentrations at seven receptor locations around the project using Halitsky's gas diffusion equation*. CAL3QHC was used to calculate maximum impacts from motor vehicles on these streets at the seven receptors.

These results conservatively assume worst case meteorology occurring simultaneously with maximum garage exhaust concentrations and maximum street traffic impacts at receptors. Maximum concentrations at the seven ground-level receptors, with background CO, are below NAAQS for one-hour and eight-hour cases. CO levels fall off further from the exhaust exit locations. Modeling of garage impacts demonstrates minimal concentrations at all the receptors examined.

Mitigation Measures

The Commonwealth's I&M program began on April 1, 1983, and has been assumed in the calculation of motor vehicle emission rates. This program, which results in the overall reduction of yearly motor vehicle emissions, was established to ensure compliance with the NAAQS on a statewide basis, as outlined in the Massachusetts State Implementation Plan. The attainment and maintenance of the NAAQS for CO in the future is dependent on the continued enforcement of this program.

Other traffic-related mitigation measures to reduce vehicle conflicts and delays could similarly improve air quality. The Transportation Impact Analysis of the FPIR outlines transportation management strategies which the Shriners Burns Institute currently employs including flexible work schedules, and plans to promote ridesharing and greater transit usage. Because the project has no predicted air quality impact at the Cambridge Street/Staniford Street intersection, further mitigation is not proposed.

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* Meteorology and Atomic Energy, 1968, p. 247.

3.7 Geotechnical

Full-time, on-site monitoring of the contractor's construction activities will be provided by the proponent's Geotechnical Engineer until the below-grade portions of the structure are completed. This will provide for independent monitoring of the contractor's compliance with the project specifications, and will enable early notification and correction of on-site problems.

Groundwater observation wells will be installed around the perimeter of the site to allow the Geotechnical Engineer to monitor the groundwater levels during the construction period to ensure that groundwater levels are maintained prior to, during, and after construction.

3.8 Solid and Hazardous Waste

Solid Waste

The estimated operational waste from the proposed research, outpatient and office space is based on current rates of waste generation at the Shriners Burns Institute and assumes similar rates for the new facility.

Increase in office space will result in an increase of approximately 8.92 tons of waste per year. It is anticipated that the waste will continue to be picked up every other week by BFI Industries from a new location in one of the three fully enclosed loading docks to the rear of the new facility, an improvement over the current in-the-open dumpster next to the Blackstone Apartments. In addition, the design calls for the waste removal truck to enter the building through truck doors and for the loading of the dumpster to occur within the building.

The increase of 40 researchers is expected to result in an additional 335 gallons of radioactive waste per year. The waste is expected to be disposed of as it is currently. The radioactive waste generated by the research laboratories is disposed of by each individual laboratory. The waste is separated and packaged and taken to the Massachusetts General Hospital dumpster dock where a technician from the Harvard University Environmental Health and Safety Department accepts it for disposal. The waste is picked up twice a week. The additional annual medical waste resulting from the increase in patients and researchers is estimated to be approximately 34.87 tons per year. This waste is picked up every morning by BFI Industries in Lawrence, Massachusetts and will continue to be picked up daily.

The new space for the dumpster will provide recycling bins to allow the initiation of a recycling program. The program is expected to include waste reduction techniques as well as recycling.

Hazardous Waste

Based on the preliminary environmental site assessment, the site does not present a threat to the environment or to the safety, health, and convenience of the public as defined in MGL Chapter 21E, and no evidence of a release of hazardous materials or petroleum products was found.

3.9 Operational Noise

The proposed Shriners Burns Institute will comply with the City of Boston noise regulations and, in fact, the noise levels are expected to be below the levels produced by the existing smaller facility. The larger structure of the Replacement Facility will also provide additional shielding of existing noise sources at some locations. Project related noise at the closest residences is also expected to be below the level considered by the Department of Housing and Urban Development as acceptable for housing.

Ambient noise level measurements were made at several locations in the vicinity of the site which were representative of the residential and institutional facilities adjacent to the site. Since noise impacts are greatest when existing noise levels are lowest, the study was designed to measure community noise levels under conditions typical of a "quiet period" for the area. The characterization of the ambient sound levels addresses the acoustical effects of local traffic, nearby institutional and more distant commercial activities, and neighborhood activities.

Predicted Noise Levels

The Replacement Facility will have similar equipment as is installed in the existing Institute. The equipment will be placed on the fifth floor of the proposed structure which is immediately above the location of the existing mechanical equipment penthouse. The fifth floor equipment will include cooling towers, water chillers, HVAC air handlers and miscellaneous pumps.

Compliance With Regulations and Mitigation Measures

The Shriners Burns Institute has made a significant commitment to noise control in the design of the facility. Construction of the Replacement Facility is expected to reduce the ambient noise levels present in the community. The City of Boston noise regulations will be complied with and, in fact, the levels are expected to be below the levels produced by the existing smaller facility.

Existing ambient noise levels were observed to exceed the City of Boston standards under conditions typical of the quiet periods for the area. By committing to comply with the Boston standard, the facility noise contribution will be well below the ambient levels. Noise reduction of various project related sources has been identified which will be necessary to achieve the overall noise control goals. Selection of the most appropriate noise control method will be identified in later stages of project design. These methods may include but are not limited to the following:

- Installation of Noise Control Louvers on some or all of the building openings.
- Installation of silencing material in the ductwork and plenums associated with the building's mechanical system.
- Arrangement of the various pieces of equipment on the fifth floor to minimize the noise exposure to building openings.
- Application of sound absorbtive material to noise sources or reflective surfaces around the sources.

3.10 Infrastructure Systems

The majority of wastewater generated by the new development is domestic sewage. The sewage generation rates have been estimated by use category based on Title V guidelines and on actual water use data available from an existing modern medical research facility, which resulted in a water use factor of 0.203 gallons per square foot per day. The total additional average domestic sewage discharge generated by the facility is projected to be 24,400 gallons per day (gpd).

Based on recent hydrant flow test data, the existing low service (LS) water system serving the project has a capacity of approximately 2400 gpm at 59 psi, which is more than adequate to supply the 50 gpm peak demand of the Shriners Burns Institute. The project also requires a fire flow of approximately 2,000 gpm. The existing high service (HS) water system is capable of supplying approximately 5,910 to 14,071 gpm at 20 psi which is more than adequate to meet the firefighting requirements of the project.

In order to minimize water use and wastewater, the Shriners Burns Institute will meet all applicable code requirements for the installation of low flow fixtures. In addition, the Institute plans to use the water resources as effectively as possible and are evaluating various operational approaches to achieve this goal. Additional measures to conserve water will include the use of plantings and fountains that require low water use.

3.11 Historic Resources

There is no known historical or archaeological significance to the existing Shriners Burns Institute site. A review of MHC files disclosed several historic structures in the vicinity and appearing on the National Register of Historic Places including:

- Otis House, 141 Cambridge Street
- Charles Street Jail, 215 Charles Street
- Old West Church, 131 Cambridge Street
- MGH Ether Dome, Fruit Street
- MGH Bulfinch Pavillion, Fruit Street

None of these structures are adjacent to the site and the new facility will not impact these historic resources. In addition, the Shriners Replacement Facility project is comparable with the height, scale and massing of other buildings surrounding the site. Project design should minimize impact on views from Regina Cleri and the Blackstone Apartments. The overall height proposed has been revised (from 155 feet to 137 feet) to minimize impacts on the adjacent St. Joseph's Church (which is included in the Inventory of Historic and Archaeological Assets of the Commonwealth and may be eligible for State or National Register listing). In addition, existing shadows have been eliminated by the new facility from the courtyard and walkway between St. Joseph's Church and the adjacent Regina Cleri House. Also, as indicated in the shadow studies discussed in Section V-2, the new facility's design has led to elimination of some existing shadows to the rear of St. Joseph's Church and on the walkway along William Cardinal O'Connell Way at various times during the year. Finally, there is no additional impact on vegetation at St. Joseph's Church, as discussed in Section V-2.

3.12 Construction

The construction period for the proposed Shriners Burns Institute is expected to last approximately three years. Typical construction hours for the project will be from 7:00 AM to 3:30 PM, Monday through Friday, although steel erection, foundation preparation, concrete pouring, and masonry work may extend to 5:30 PM on weekdays.

A Construction Management Plan (CMP) will be submitted to the Boston Transportation Department for approval prior to the start of construction. The CMP includes specific mitigation measures and staging plans to minimize impacts to the abutters.

4.0 CORRESPONDENCE

The following documents have been issued to date by the Boston Redevelopment Authority:

4.1 BRA Scoping Document
4.2 BRA Adequacy Determination on DPIR, April 23, 1992
4.3 Boston Redevelopment Authority Board Vote, April 9, 1992

4.1 BRA Scoping Document

BOSTON REDEVELOPMENT AUTHORITY
SCOPING DETERMINATION

SHRINERS BURNS INSTITUTE
REPLACEMENT FACILITY PROJECT

SUBMISSION REQUIREMENTS
FOR DRAFT PROJECT IMPACT REPORT (DPIR)

PROPOSED PROJECT:	Shriners Burns Institute Replacement Facility Project
PROJECT LOCATION:	51 Blossom Street
APPLICANT:	Shriners Hospital for Crippled Children

The Boston Redevelopment Authority ("BRA") is issuing this Scoping Determination pursuant to Section 31-5 of the Boston Zoning Code (the "Code"). The applicant filed a Project Notification Form ("PNF") on March 19, 1991. The Scoping Determination requests information required by the BRA for its review of the Proposed Project in connection with the following:

(a) Development Review pursuant to Article 31 of the Code;

(b) Recommendations to the Board of Appeal with respect to the zoning relief and applicable Interim Planning Overlay District ("IPOD") requirements for the Proposed Project, pursuant to Articles 6, 7, and 27D of the Code;

(c) Approval of a Development Impact Project Plan, pursuant to Article 26A of the Code, and the entering of agreements for the Development Impact Project Contribution and Jobs Contribution Grant, pursuant to Articles 26A and 26B of the Code; and

(d) Modification of pertinent provisions of the West End Redevelopment Plan and the Land Disposition Agreement between the Boston Redevelopment Authority and the Shriners Hospital for Crippled Children, dated March 30, 1964.

PREAMBLE

The BRA is reviewing the Proposed Project pursuant to multiple sections of the Code. The Proposed Project is being reviewed pursuant to Article 31, Development Review Requirements, which sets out a comprehensive procedure for project review and requires the BRA to review the design, transportation, environmental, and other impacts of proposed projects. Article 31 requires the submission of a satisfactory Final Project Impact Report prior to the issuance of a building permit.

I. SHRINERS BURNS INSTITUTE PROPOSED PROJECT DESCRIPTION

The Shriners Hospital for Crippled Children is a charitable organization which provides, entirely free of charge, state-of-the-art medical care to children who suffer burn-related injuries. Since 1968, the Shriners has operated the Boston Burns Institute at 51 Blossom Street. The Institute enjoys an affiliation with Massachusetts General Hospital, under which physicians have dual appointments and MGH provides emergency backup care to Shriners patients.

In March of 1991, the Shriners submitted a Project Notification Form (PNF) to the Authority indicating its plans to construct a replacement facility on the site of the existing facility. The multi-phased project calls for the existing facility to remain in operation until new hospital space is constructed above a steel truss which will span the existing building. Following completion of the new hospital space, the existing facility will be razed and replaced with research space, an auditorium, and a parking garage.

Specifically, Shriners proposes to (1) demolish 80,000 SF of existing space, (2) construct a 200,000 SF replacement facility (eleven stories, 155 feet in height at the highest point), and (3) construct a 70,000 SF, 150-space parking garage. The total gross square footage of the Proposed Project is 270,000 square feet. This total reflects an increment of 190,000 gross square feet. The Proposed Project will result in the Burns Institute's having additional medical research space, increased patient bed space (although the number of beds will remain at 30) and outpatient care space, an auditorium, a lobby, and enclosed parking for approximately 150 cars.

The existing land area of the Burns Institute is 39,200 SF (.90 acres). The existing facility has a gross floor area of 80,000 SF, yielding a gross floor area ratio (FAR) of 2.4. The addition of 190,000 gross FAR square feet will create a new gross floor area of 270,000 SF and a gross floor area ratio of 6.89.

II. APPLICABLE ZONING PROVISIONS AND REQUIRED RELIEF

The area in which the Proposed Project is located is currently zoned H-3 by the Boston Zoning Code. Numerous provisions of the Boston Zoning Code apply to the Proposed Project. The Proposed Project requires: (1) variances pursuant to Article 7 of the Code; (2) conditional use permits pursuant to Article 6 of the Code; (3) Development Impact Project ("DIP") Plan approval pursuant to Articles 26A and 26B of the Code; and (4) an Interim Planning permit, pursuant to Article 27D of the Code. In order to be granted each type of zoning relief, a different set of criteria must be satisfied.

Variances

The Proposed Project requires variances for Floor Area Ratio, front, rear and side yard setbacks, as well as parapet setback. Conditions required for approval of variances are outlined in Section 7-3 of the Code.

Conditional Use Permits

The Proposed Project also requires conditional use permits for (1) conducting scientific research in an H-3 district (Section 8-7 (24)); (2) housing of laboratory animals in an H-3 district (Section 8-7 (77)); and (3) an off-street parking garage in a restricted parking district (Section 6-3A). Conditions required for approval of a conditional use permit are outlined in Section 6-3 of the Code.

Interim Planning Permit

The Proposed Project also requires an Interim Planning Permit. To receive such a permit, (a) the Proposed Project's benefits to the community must outweigh the burdens imposed, and (b) the Proposed Project must be in substantial accord with the standards of the Downtown Interim Planning Overlay District listed in Section 27D, as further described in Section II below.

Development Impact Project Plan Approval

The Proposed Project also requires DIP approval pursuant to Articles 26A, Development Impact Projects - Housing, and 26B, Development Impact Projects - Job Training. Prior to receiving the zoning relief listed above, the Applicant must meet the DIP requirements, pursuant to Sections 26A-3 and 26B-3 of the Code. These requirements include that the BRA approve the DIP Plan after a public hearing, and that the Applicant enter into a DIP Agreement with the BRA.

III. REQUIRED MODIFICATIONS OF APPLICABLE PLANS AND AGREEMENTS

The Proposed Project is located within the West End Urban Renewal Project Area. Consequently, approval of the Proposed Project requires that the Authority modify the pertinent provisions of the West End Redevelopment Plan. In addition, the Proposed Project requires a modification of the Land Disposition Agreement regarding the Sale and Conveyance of Parcel No. 8 of the West End Land Assembly and Redevelopment Plan, entered into by the Authority and the Shriners Hospital for Crippled Children and dated March 30, 1964.

IV. DOWNTOWN INTERIM PLANNING OVERLAY DISTRICT

On September 21, 1987, the Boston Zoning Commission amended the Boston Zoning Code to incorporate Article 27D, the Downtown Interim Planning Overlay District (IPOD) in order to facilitate rezoning of land in Downtown Boston and to provide the proper balance among competing land uses and economic and environmental factors. The IPOD remains in effect until March 25, 1992.

The Proposed Project is located in Subdistrict M of the Downtown IPOD. The provisions of the IPOD, together with the provisions of the underlying zoning, constitute the zoning for the site. Where conflicts between the IPOD and underlying zoning exist, the provisions of the IPOD shall govern, except with respect to building height and floor area ratio, in which case the more restrictive provisions shall govern.

V. COMMUNITY REVIEW OF THE PROPOSED PROJECT

The Proposed Project is proceeding through a comprehensive community review process in which the following community groups, abutters, and other entities are participating: Beacon Hill Civic Association, Cambridge Street CDC, Hawthorne Place Condominium Association, Prynne Realty Trust, Blackstone Senior Citizens Housing Development, St. Joseph's Parish/Regina Cleri, and Massachusetts General Hospital.

The principal concerns raised thus far by abutters relate to: (1) the height and massing of the building; (2) potential wind and shadow effects; (3) the size of the proposed parking gargage component of the Proposed Project and traffic impacts related to the garage; (4) the locations of entrance and exit ramps for the parking garage; and (5) impacts to be created during construction of the Proposed Project. Proponents of the Proposed Project are addressing the community's concerns in the ongoing community review process through subsequent meetings with abutters and community groups. It is anticipated that the community review process will be completed within 90 days.

VI. DEVELOPMENT REVIEW REQUIREMENTS - ARTICLE 31

SUBMISSION REQUIREMENTS

In addition to full-size scale drawings, 15 copies of a bound booklet containing all submission materials reduced to size 8-1/2" x 11", except where otherwise specified, are required. The booklet should be printed on both sides of the page. In addition, an adequate number of copies must be available for community review. Included in the submission materials should be a copy of this Scoping Determination for review.

A. GENERAL INFORMATION

1. Applicant Information
   a. Development Team

      (1) Names

         (a) Developer (including description of development entity and type of corporation)

         (b) Attorney

         (c) Project consultants

      (2) Business address and telephone number for each

      (3) Designated contact for each

      (4) Description of currently- or formerly-owned developments in Boston

   b. Legal Information

      (1) Legal judgments or actions pending concerning the Proposed Project

      (2) Evidence of site control over the project area, including current ownership and purchase options of all parcels in the proposed project, all restrictive covenants and contractual restrictions affecting the proponent's right or ability to accomplish the proposed project and the nature of the agreements for securing parcels not owned by the prospective developer.

      (3) Nature and extent of any and all public easements into, through, or surrounding the site.

2. Financial Information (See Appendix 1 for required financial information)

   Development and Operating Pro Formas must be provided for the proposed project.

   a. Full disclosure of names and addresses of all financially involved participants and bank references

b. Development Pro Forma

c. Ten (10) Year Operating Pro Forma

3. Project Area

a. Description of metes and bounds of project area or certified survey of project area

4. Public Benefits

a. Development Impact Project Contribution and Jobs Contribution Grant specifying amount of housing linkage and jobs linkage contributions and method of housing linkage contribution (housing payment or housing creation)

b. Adjustment in tax revenues, specifying existing and estimated future Payment In Lieu of Taxes (Pilot)

c. Anticipated employment levels including the following:

(1) Estimated number of construction jobs

(2) Estimated number of permanent jobs

d. Other public benefits, if any, to be provided.

5. Regulatory Controls and Permits

a. Existing zoning requirements, zoning computation forms, and any anticipated requests for zoning relief should be explained.

b. Anticipated permits required from other local, state, and federal entities with a proposed application schedule should be noted.

c. If the Proposed Project becomes subject to the Massachusetts Environmental Policy Act (MEPA), required documentation should be provided including copies of the Environmental Notification Form and a proposed schedule for coordination with BRA procedure.

6. Community Groups

a. Names and addresses of project area owners, displacees, abutters, and also any community groups which, in the opinion of the applicant, may be substantially interested in or affected by the proposed project

b. A list of meetings proposed and held with interested parties

B. TRANSPORTATION COMPONENT

A Transportation Access Plan shall be prepared as defined by the Scope of Services outlined in Appendix 2.

C. ENVIRONMENTAL PROTECTION COMPONENT

1. Wind

A qualitative analysis of the potential wind impacts of the proposed building at the pedestrian level shall be required for the Draft Project Impact Report. This analysis shall determine potential pedestrian level winds adjacent to and in the vicinity of the project site and shall identify any areas where wind velocities are expected to exceed acceptable levels, including the Authority's guideline of an effective gust velocity of 31 mph not to be exceeded more than 1% of the time.

Particular attention shall be given to public and other areas of pedestrian use, including, but not limited to, building entrances, sidewalks adjacent to the building, and the courtyard of the adjacent Massachusetts General Hospital.

For areas where wind speeds are projected to exceed acceptable levels, measures to reduce wind speeds and to mitigate potential adverse impact shall be identified.

Should the qualitative analysis indicate the possibility of excessive pedestrian level wind speeds, additional studies, including quantitative wind tunnel testing, may be required for the Final Impact Report.

2. Shadow

A shadow analysis shall be required for existing and build conditions for the hours 9:00 a.m., 12:00 noon, and 3:00 p.m. for the vernal equinox, summer solstice, autumnal equinox, and winter solstice. It should be noted that due to time differences (daylight savings vs. standard), the autumnal equinox shadows would not be the same as the vernal equinox shadows and therefore separate shadow studies are required for the vernal and autumnal equinoxes.

The shadow impact analysis must include net new shadows as well as existing shadow and must clearly show the incremental impact of the proposed building.

Particular attention shall be given to existing or proposed public open spaces and major pedestrian areas, including, but not limited to, the sidewalks adjacent to the building and the courtyard of the adjacent Massachusetts General Hospital.

Design or other mitigation measures to limit or minimize any adverse shadow impact shall be identified.

3. Daylight Analysis

A daylight analysis for both build and no-build conditions shall be conducted by measuring the percentage of skydome that is obstructed by the proposed project building. The areas of interest shall be Blossom Street and Wm. Cardinal O'Connell Way. Sample analyses should be taken for each major building element. The BRADA program (available from the BRA) shall be used for the analysis.

4. Solar Glare Analysis

An analysis of the solar glare impact of the proposed building shall be required. The purpose of this analysis shall be to measure reflective glare from the building's facade onto nearby streets and arterials in order to determine the potential for visual impairment due to reflective spot glare. Mitigation measures to eliminate any adverse reflective glare shall be identified.

5. Air Quality

A future air quality (carbon monoxide) analysis shall be required for any intersection where level of service is expected to deteriorate to D and the project causes a 10 percent increase in traffic or where the level of service is E or F and the project contributes to a reduction of LOS. The methodology and parameters of the traffic-related air quality analysis shall be approved in advance by the Massachusetts Department of Environmental Protection and the Boston Redevelopment Authority. Mitigation measures to eliminate or avoid any violation of air quality standards shall be described.

A description of the garage exhaust system, and of the exhaust system for the hospital laboratories, including location of exhaust vents and specifications, and an analysis of the impact on pedestrian level air quality from operation of the exhaust systems shall be required. Measures to avoid any violation of air quality standards shall be described.

6. Geotechnical Impact

An analysis of existing sub-soil conditions, groundwater levels, potential for ground movement and settlement during excavation, and potential impact on adjacent buildings and utility lines and maintenance of groundwater levels shall be required. This analysis shall also include a description of the foundation construction methodology, the amount and method of excavation, disposal of the excavate, measures to prevent any adverse effects on adjacent buildings and utility lines, and measures to ensure that groundwater levels will not be lowered during or after construction.

7. Solid and Hazardous Wastes

Identification of the potential for the presence or disposal of any oil or hazardous wastes and of buried tanks on or within the site shall be required. It is recommended that a site assessment in compliance with M.G.L. Chapter 21E be submitted with the Draft Project Impact Report.

Identification of the generation, storage, and disposal of solid wastes (construction period and operation of the project) and of any hazardous wastes or contaminants, including biomedical wastes, are required and must be described in the DPIR. Measures to promote recycling and reduction of waste generation are required and must be described in the DPIR.

8. Noise

An analysis of the potential noise impacts from the building's mechanical and exhaust systems and compliance with applicable regulations of the City of Boston shall be required. A description of the building's mechanical and exhaust systems and their location shall be included. Measures to minimize and eliminate adverse noise impacts on adjacent hospital facilities and residential properties shall be identified.

9. Construction Impacts

A construction impact analysis shall include a description and evaluation of the following:

(1) potential dust and pollutant emissions and mitigation measures to control these emissions and avoid adverse impacts on patients of the Burns Institute and adjacent hospital facilities and residents of the adjacent elderly housing.

(2) potential noise impact and mitigation measures to minimize increase in noise levels and avoid any adverse

impacts on patients of the Burns Institute and adjacent hospital facilities and residents of the adjacent elderly housing.

(3) location of construction staging areas and construction worker parking.

(4) construction schedule, including hours of construction activity.

(5) access routes for construction trucks and anticipated volume of construction truck traffic.

(6) impact on existing groundwater levels and measures to control groundwater.

(7) method of demolition of the existing building, control of emissions, and disposal of demolition waste, including identification of the disposal site.

(8) measures to protect the public safety of pedestrians in the vicinity of the work areas and patients in adjacent hospital facilities.

10. Rodent Control

An analysis of the impact of project construction on rodent populations and a description of the proposed rodent control program, including proposed frequency of application, and compliance with applicable City and State regulatory requirements shall be required.

D. URBAN DESIGN COMPONENT

As a prelude to the discussion of urban design issues related to the Proposed Project, the Proponent is requested to provide narrative information on: (1) the need for the Proposed Project; (2) consideration given to alternatives to the Proposed Project; and (3) consideration given to alternative locations for the Proposed Project.

The proposed project elements should be developed so as to (1) strengthen the overall urban design character of the site, (2) enhance the relationships among existing buildings; and (3) augment the existing pedestrian environment. The proposed project elements should also be designed and constructed so as to minimize impacts on view angles in the surrounding area. Alternative design scenarios which would result in reduced height and massing of the new structure should also be explored.

In order to determine that the proposed project: (a) is architecturally compatible with surrounding structures; (b) exhibits an architectural concept that enhances the urban design features of the area in which it is located; and (c) augments the quality of the pedestrian environment, a design review process, comprised of three phases, must be completed. These are identified as the Schematic Design, Design Development, and Contract Documents review phases. For the Schematic Design Phase, the following items must be submitted:

1. Written description of program elements and space allocation for each element.

2. Plan for the surrounding area and district and sections at an appropriate scale (1" = 50' or larger) showing relationships of the proposed project to the surrounding area and district:

    a. massing

    b. building height

    c. scaling elements

    d. open space

    e. major topographic features

    f. pedestrian and vehicular circulation

    g. land use

3. Black and white 8"x10" photographs of the site and neighborhood

4. Sketches and diagrams of earlier proposals to clarify design issues and massing options

5. Eye-level perspective (reproducible line drawings) showing the proposal in the context of the surrounding area

6. Aerial views of the project

7. Site sections at 1" = 20' or larger showing relationships to adjacent buildings and spaces

8. Site plan at an appropriate scale (1" = 20' or larger) showing:

    a. general relationships of proposed and existing adjacent buildings and open space

b. open spaces defined by buildings on adjacent parcels and across streets

c. general location of pedestrian ways, driveways, parking, service areas, streets, and major landscape features

d. pedestrian, handicapped, vehicular and service access and flow through the parcel and to adjacent areas

e. survey information, such as existing elevations, benchmarks, and utilities

f. phasing possibilities

g. construction limits

9. Massing model at 1" = 40' for use in the Authority's base model and a study model at 1" = 16' showing facade design.

10. Drawings at an appropriate scale (e.g., 1" = 8') describing architectural massing, facade design and proposed materials including:

    a. building and site improvement plans

    b. elevations in the context of the surrounding area

    c. sections showing organization of functions and spaces

    d. preliminary building plans showing ground floor and typical upper floor(s)

11. Proposed schedule for submittal of design development materials

Submission materials for Design Development and Contract Documents submissions can be found in Appendix 3.

E. HISTORIC RESOURCES COMPONENT

A historic resource analysis must assess the impacts of the proposed project's height, scale, massing, and other relevant environmental factors on any historic districts or buildings in the vicinity of the Proposed Development. The DPIR must also assess the potential presence of any archaeological resources which may be disturbed by the construction of the

Proposed Project.

F. INFRASTRUCTURE SYSTEMS COMPONENT

The Applicant must submit a description of the Proposed Project's anticipated water and electricity consumption, sewage generation, and energy requirements. (Energy requirements include electricity, gas, steam, and other utilities, but are not meant to include thermal transfer values or insulation efficiency, except as a possible mitigating measure). In addition, the Applicant's submission must include an evaluation of the Proposed Project's impact on the capacity and adequacy of existing water, sewage, energy, and electrical (telephone, cable, etc.) utility systems, and the need reasonably attributable to the Proposed Project for additional systems facilities. The description and evaluation referenced above must include comparisons of the Proposed Project's use/generation levels with those of the existing Facility. Additionally, use/generation information on other proposed projects in the area should be included as background demand in capacity evaluations with the utilities involved.

The Applicant's submission must also include discussion of any special needs as they relate to a hospital complex, for example cooling, heating, powered equipment, bioactive waste screening and sanitation, etc. The submission should also include a brief description of related emergency systems, i.e., electric generators, fire systems, and water supply. Systems improvements must be planned in such a way that no interruption of water, sewage, energy, or electrical systems occurs to the existing hospital complex.

Any system upgrading or connection requiring a significant disruption in vehicular or pedestrian circulation, or affecting any public or neighborhood park or streetscape improvements, is an impact which must be accurately assessed and mitigated. A plan must be provided which identifies the specific user areas affected, the proposed relocation configuration and phasing, anticipated impacts, and mitigation measures, if necessary. Measures to conserve resources, such as recycling, must be identified.

The Applicant must conduct a thorough consultation with representatives of all utilities and should reference all such consultations in the infrastructure impact analysis.

Appendix 1

REQUIRED FINANCIAL INFORMATION

REQUIRED FINANCIAL INFORMATION
SHRINERS BURNS INSTITUTE

DEVELOPMENT PRO FORMA includes all the information normally found in a development proforma, by phase. This includes, but is not limited to:

- Land costs, per land square foot and total, by parcel, including any incremental disposition cost attributed to the project.
- Attribution of acquisition expense over project components (per FAR square foot, clinical, research, office, etc.)
- All hard costs on a per-unit and total basis by phase (disaggregated into base building, tenant improvement work, garage, site work, furniture, fixtures and equipment, FF&E, etc.)
- All soft costs on a per-unit and total basis, (disaggregated into individual line items such as architectural, engineering, legal, accounting, and developer's fees, and any other professional fees, insurance, permits, real estate tax during construction, etc.)
- All contingencies, on a per-unit and total basis, by phase (specify whether contingency is on hard costs, soft cost, or total cost).
- All assumptions regarding financing terms on acquisition, pre-development, construction and permanent loans, by phase (including financing fees, interest rates, drawdown assumptions, terms, participations, amortization).
- Calculation of housing and jobs linkage obligations, and anticipated payment method (over term of obligation or on a net present value basis).
- Any other project-related expenses not within any of the above categories.
- Calculation of Total Development Cost (TDC) by component, including total and per unit breakdown (e.g., per square foot clinical, research, office, etc.).
- Sources of debt and equity for total project costs.
- Projected financing sources, including bond-issuing agencies such as HEFA or MIFA, banks, institutional investors, private, corporate or government donors (an analysis of the

costs versus benefits of the financing options, including interest costs and loan term, as well as a comparison of available sources, should be included).

- Appropriate return measures, if applicable, (return on equity, return on total development cost, net present value, internal rate of return; specify method of calculation and hurdle rates).

10-YEAR OPERATING PRO FORMA includes all the information normally found in an operating pro forma, on a yearly basis. This includes, but is not limited to:

- Tabulation of gross and net (leasable) square feet for all clinical, research, office or other uses.

- Schedule of all rents on a per square foot and total basis of space not operated directly by the institution.

- Anticipated operating expenses, real estate taxes, and payments in lieu of taxes (PILOT) on per square foot and total basis, and clear explanation of division of expenses between owner and tenant (includes all commercial space and parking garage).

- All other expense and vacancy assumptions including property management fees, set forth to calculate cash available for debt service.

- Anticipated leasing patterns (5-year, 10-year, etc.,) and lease-up rates, if any.

- Calculation of debt service.

- Anticipated timing of future refinancing or sale.

- For any research space, projections of grant income from government, corporate, philanthropic, or other entities.

Appendix 2

TRANSPORTATION ACCESS PLAN SCOPE OF SERVICES

SCOPE OF SERVICES
TRANSPORTATION ACCESS PLAN
SHRINERS BURNS INSTITUTE
BOSTON, MASSACHUSETTS

SCOPE OF SERVICES

A. DESCRIPTION OF SERVICES

Shriners Burns Institute should prepare a Transportation Access Plan for the proposed new construction project in accordance with the requirements of the Boston Redevelopment Authority (BRA) and the Boston Transportation Department (BTD). The Access Plan should include the following:

- o A definition of existing traffic, parking and transit conditions in the area.
- o An evaluation of the project's short-term traffic impacts related to construction activity.
- o An evaluation of long-term impacts on traffic, parking and public transportation.
- o Consideration of loading and service vehicles.
- o Identification of appropriate measures to mitigate project impacts.
- o Monitoring program of long-term travel behavior.

The Access Plan should incorporate information from previous transportation studies conducted in the area. Other significant projects which will influence area travel demands will be considered in the study.

B. STUDY AREA

The study should be limited to the area shown in Figure 1. Since the primary access to the project area is provided via Cambridge and Blossom Streets, William Cardinal O'Connell Way, and Staniford Street, traffic analysis will focus on these roadways and the following intersections:

- o Cambridge and Blossom Streets
- o Blossom Street and William Cardinal O'Connell Way
- o William Cardinal O'Connell Way and Staniford Street

C. DEFINITION OF TASKS

Task 1 - Identification of Existing Transportation Conditions

Shriners Burns Institute should compile data on supply and usage characteristics of the various transportation systems within the study area.

1.1 Traffic. New traffic data should be collected where counting is necessary to expand upon available information. Based on data from all sources, a traffic volume network should be developed to represent traffic conditions when Cambridge and Blossom Streets, William Cardinal O'Connell Way, and Staniford Street are not under construction.

1.2 Parking. Current supply and utilization of parking will be presented. Use of parking will be classified according to user type: patient, visitor, doctor, nurse, administrative, etc. Hours of use and turnover rates will be presented. Rates charged to users of all types will be presented. Parking supply and demand characteristics for the surrounding area will be presented, based on BTD 1991 Parking Survery Update (selected data available on a preliminary basis from BTD July 1).

1.3 Transit. Transit use to and from the existing facility should be presented in terms of the percentage of transit use among each staff category (doctors, nurses, administrative staff, etc.).

Task 2 - Evaluation of Long-Term Transportation Impacts

Expected long-term transportation impacts in the study area should be estimated and evaluated.

2.1 Trip Generation. The development program should be analyzed to estimate net new peak-hour and daily trips by mode. To estimate net new trips by mode, time of day, and direction, travel demand data should be gathered from a selected group of faculty and research assistants who should be occupying the new facility. Such information should include work patterns (start and end times), mode of arrival, auto occupancy, and residence location.

2.2 Conditions to be Analyzed. The following time frames and conditions should be analyzed:

- o 1991 Existing
- o 1994 No-Build (assuming the project is not built), and
- o 1994 Build (assuming No-Build traffic plus project trips).

2.3 Background Development. Building construction projects to be included in the No-Build and Build evaluations should be defined and reviewed with BRA and BTD staff prior to the analysis.

2.4 Impact Analysis. Net new trips expected to be created by the proposed development should be added to the traffic expected under No-Build conditions. AM and PM peak hour impacts should be analyzed as described below:

1. Traffic Impacts - Volume/capacity ratio (V/C), delay, and level-of-service (LOS) calculations at the analysis intersections should be completed.

2. Parking Impacts - New parking demand generated by the project will be calculated and compared with proposed new supply and existing supply in surrounding area to identify deficiency or surplus. The analysis will discuss long-term (employee) vs. short-term (patient/visitor) parking needs, and indicate proposed allocations of spaces between the two types.

3. Loading/Service/On-Site Circulation Accommodation of trucks and service vehicles on the site should be discussed, as should site circulation and on-site truck maneuvering.

4. Transit Impacts - The number of transit trips generated by the project should be presented.

Task 3 - Evaluation of Short-Term Impacts (construction period). The transportation assessment should include an evaluation of the impacts of the project during the construction period, including the following:

1. Estimated number of daily construction worker trips by mode;

2. Frequency, times, and routes of truck movements and construction activities;

3. Provisions for construction worker parking and construction materials deliveries;

4. Temporary storage of construction equipment and materials; and

5. The need (if any) for street occupancy permits during construction.

Task 4 - Development of Mitigation Measures. Mitigation measures which would lessen the impacts of the proposed project on the transportation system should be identified. The effect of these measures should be determined either through application of analysis techniques identified under Tasks 2 and 3 or through appropriate qualitative review. Depending on the extent of transportation deficiencies caused by the project, mitigation measures may include:

- Travel-demand modifications;
- Roadway/traffic operation improvements;
- Transit improvements; and
- Construction management.

Specific commitments to be made by the developer should be identified.

Task 5 - Identification of Long-Term Monitoring (following completion of the project). A long-term program to monitor the travel behavior of project users should be developed. The program should outline the procedure to be used to collect the following information:

- Travel mode and time of arrival and departure;
- Vehicle occupancy rate; and
- Residence location.

Task 6 - Report Preparation. The results of the above effort should be incorporated into a "Transportation Access Plan" which should describe the work performed during the study and document the study process, procedures, and findings for use by the BRA and the BTD.

Appendix 3

SUBMISSION REQUIREMENTS FOR DESIGN DEVELOPMENT AND CONTRACT DOCUMENTS SUBMISSIONS

Phase II Submission: Design Development

1. Revised written description of project.

2. Revised site sections.

3. Revised site plan showing:

    a. Relationship of the proposed building and open space and existing adjacent buildings, open spaces, streets, and buildings and open spaces across streets.

    b. Proposed site improvements and amenities including paving, landscaping, lighting and street furniture.

    c. Building and site dimensions, including setbacks and other dimensions subject to zoning requirements.

    d. Any site improvements or areas proposed to be developed by some other party (including identification of responsible party).

    e. Proposed site grading, including typical existing and proposed grades at parcel lines.

4. Dimensioned drawings at an appropriate scale (e.g., 1" = 8') developed from approved schematic design drawings which reflect the impact of proposed structural and mechanical systems on the appearance of exterior facades, interior public spaces, and roofscape including:

    a. Building plans

    b. Preliminary structural drawings

    c. Preliminary mechanical drawings

    d. Sections

    e. Elevations showing the project in the context of the surrounding area as required by the Authority to illustrate relationships or character, scale and materials.

5. Large-scale (e.g., 3/4" = 1'-10") typical exterior wall sections, elevations and details sufficient to describe specific architectural components and methods of their assembly.

6. Outline specifications of all materials for site improvements, exterior facades, roofscape, and interior public spaces.

7. Eye-level perspective drawings showing the project in the context of the surrounding area.

8. Samples of all proposed exterior materials.

9. Complete photo documentation 35 mm color slides) of above components including major changes from initial submission to project approval.

Phase III Submission: Contract Documents

1. Final written description of project.

2. A site plan showing all site development and landscape details for lighting, paving, planting, street furniture, utilities, grading, drainage, access, service, and parking.

3. Complete architectural and engineering drawings and specifications.

4. Full-size assemblies (at the project site) of exterior materials and details of construction.

5. Eye-level perspective drawings or presentation model that accurately represents the project, and a rendered site plan showing all adjacent existing and proposed structures, streets and site improvements.

6. Site and building plan at 1" - 100' for Authority's use in updating its 1" = 100" photogrammetric map sheets.

Phase IV Submission: Construction Inspection

1. All contract addenda, proposed change orders, and other modifications and revisions of approved contract documents which affect site improvements, exterior facades, roofscape, and interior public spaces shall be submitted to the Authority prior to taking effect.

2. Shop drawings of architectural components which differ from or were not fully described in contract documents.

4.2 BRA/Preliminary Adequacy Determination on DPIR, April 23, 1992

REDEVELOPMENT
AUTHORITY

Raymond L. Flynn
Mayor

Stephen Coyle
Director

One City Hall Square
Boston, MA 02201
(617) 722-4300

April 23, 1992

Mr. Burton E. Ravellette, Jr.
Owner Representative
Shriners Hospital for Crippled Children
Boston Burns Institute
51 Blossom Street
Boston, MA 02114

**Re: Shriners Burns Institute
Replacement Facility Project**

This letter is the Preliminary Adequacy Determination (the "Determination") of the Boston Redevelopment Authority (the "BRA") with respect to the Draft Project Impact Report (the "DPIR") for the proposed Shriners Burns Institute Replacement Facility Project (the "Proposed Project").

The BRA is issuing this Determination pursuant to Section 31-5 of the Boston Zoning Code (the "Code"). This Determination requests additional information required by the BRA for its review pursuant to Article 31 of the Code.

The BRA is reviewing the Project pursuant to multiple sections of the Code. The Proposed Project is being reviewed pursuant to Article 31 of the Code, Development Review Requirements, which sets out a comprehensive procedure for project review, and requires the issuance of a Final Adequacy Determination prior to issuance of a building permit. The Final Adequacy Determination is issued upon determination by the BRA that the Final Project Impact Report (the "FPIR") is satisfactory.

But for the required corrections, clarifications, and additional information referenced in the attached Technical Appendix, the DPIR submitted is sufficient to satisfy the scoping requirements.

We look forward to reviewing the Final Project Impact Report.

Sincerely,

Gerard Kavanaugh

Gerard Kavanaugh
Assistant Director for Institutional Planning
and Development

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TECHNICAL APPENDIX
TO THE
PRELIMINARY ADEQUACY DETERMINATION
FOR
SHRINERS BURNS INSTITUTE
REPLACEMENT FACILITY PROJECT

A. DEVELOPMENT REVIEW REQUIREMENTS - ARTICLE 31

Article 31 of the Code institutes a process by which large-scale development projects will be reviewed by the BRA. In its review of the DPIR, the BRA has identified certain components which are insufficient and which the Proponent must modify, and additional information which the BRA requires in order to issue a Final Adequacy Determination. The following is a description of the sufficiency of the materials submitted in the DPIR, and the additional materials which the Proponent must include in the FPIR.

1. GENERAL INFORMATION

The general information provided in the DPIR is sufficent to satisfy the scoping requirements.

2. TRANSPORTATION COMPONENT

The Boston Transportation Department ("BTD") is currently drafting a Transportation Access Plan ("TAP") Agreement for execution between the City of Boston and the Proponent. A TAP Agreement must be finalized prior to the formal issuance of an Adequacy Determination by the BRA.

3. ENVIRONMENTAL COMPONENT

The analyses of wind, shadow, daylight, solar glare, air quality, geotechnical, water quality, construction and rodent control impacts presented in the DPIR are sufficient to satisfy the scoping requirements. More detailed information must be provided in the FPIR on the proposed recycling/waste reduction program, including commitments to the program. In addition, the FPIR must include a map indicating sensitive receptor locations and heights.

4. URBAN DESIGN COMPONENT

The information presented in the DPIR, together with the submission of required schematic documents, indicate an acceptable schematic design for the Project. The FPIR must include include information noting the design changes voted upon by the BRA Board at its April 9, 1992 meeting.

5. HISTORIC RESOURCES COMPONENT

The information provided in the DPIR concerning historic resources is sufficent to satisfy the scoping requirements.

6. INFRASTRUCTURE SYSTEMS COMPONENT

The information provided in the DPIR concerning infrastructure systems is sufficent to satisfy the scoping requirements, but for the following information which the FPIR must include:

- Information on the differences between existing and proposed buildout conditions;
- Locations of hydrants (for tests);
- Description of BTE steam system service connections;
- Quantification of any water loss associated with cooling tower blowdown; and
- Evidence of correspondence with Boston Edison concerning the design of electrical vaults; and

The FPIR must also include a determination from the BWSC that the water and sewer facilities serving the existing facility are adequate to served the expanded facility.

B. AGREEMENTS

In addition to completing the Development Review Requirements process, the agreements, plans and documents listed below must be provided in form and content satisfactory to the appropriate signatory public agencies before building permits may be issued for the Project:

A) Development Impact Project (DIP) Agreement, including provisions for Jobs Contribution Grant and Housing Contribution Grant, pursuant to Articles 26A and 26B of the Code;

B) Transportation Access Plan (TAP) Agreement;

C) Traffic Maintenance Plan in conformity with the City's Construction Management Program;

D) Boston Residents Construction Employment Plan, pursuant to Chapter 12 of the Ordinances of 1986 of the City of Boston, as amended by Chapter 17 of said Ordinances, and Executive Order Extending Boston Residents Job Policy, signed by the Mayor on July 12, 1985;

E) First Source Agreement with the Mayor's Office of Jobs and Community Services; and

F) Amendment to the Sales Contract for the West End Project Area, entered into March 30, 1964, including such terms and conditions as the Director deems appropriate and in the best interest of the BRA.

4.3 Boston Redevelopment Authority Board Vote, April 9, 1992

MINUTES OF THE REGULAR MEETING
OF THE BOSTON REDEVELOPMENT AUTHORITY
APRIL 9, 1992

The Members of the Boston Redevelopment Authority met in regular session at the office of the Authority, Board Room, City Hall, One City Hall Square, Boston, Massachusetts at 2:00 p.m. on April 9, 1992. The meeting was called to order by the Chairman, and upon roll call, those present and absent were as follows:

Present	Absent
Clarence J. Jones	
James K. Flaherty	
Michael F. Donlan	
Francis X. O'Brien	
Consuelo Gonzales Thornell	

A copy of the NOTICE OF MEETING, pursuant to Section 23B of Chapter 39, as amended, of the General Laws, with CERTIFICATE AS TO SERVICE OF NOTICE OF MEETING attached thereto, was read and ordered spread upon the minutes of this meeting and filed for record.

NOTICE OF MEETING

Notice is hereby given in accordance with Section 23B of Chapter 39, as amended, of the General Laws that a regular meeting of the Boston Redevelopment Authority will be held at 2:00 p.m. on April 9, 1992, in the Boston Redevelopment Authority Board Room, City Hall, One City Hall Square, in the City of Boston, Massachusetts.

BOSTON REDEVELOPMENT AUTHORITY

By Kane Simonian

Title Secretary

April 7, 1992

CERTIFICATE AS TO SERVICE OF NOTICE OF MEETING

I, Kane Simonian, the duly authorized, qualified Secretary of the Boston Redevelopment Authority, do hereby certify that on April 7, 1992, I filed in the manner provided by Section 23B of Chapter 39, as amended, of the General Laws, with the City Clerk of the City of Boston, Massachusetts, a NOTICE OF MEETING, of which the foregoing is a true and correct copy.

IN TESTIMONY WHEREOF, I have hereunto set my hand and the seal of said Authority this Seventh day of April, 1992.

Kane Simonian

Secretary

LS

Messrs. Chandler and Simonian attended the meeting.

The Minutes of the meeting of March 26, 1992 (which were previously distributed) were submitted.

On motion duly made and seconded, it was unanimously

VOTED: To adopt the Minutes as submitted.

The Chairman opened a Public Hearing before the Boston Redevelopment Authority, being held in conformance with Articles 26A and 26B of the Boston Zoning Code to consider a Development Impact Project Plan proposed for the Boston Burns Institute at 51 Blossom Street.

Copies of a memorandum dated April 9, 1992 were distributed entitled "PUBLIC HEARING CONCERNING A DEVELOPMENT IMPACT PROJECT PLAN SUBMITTED BY THE SHRINERS BURNS INSTITUTE IN CONNECTION WITH THE PROPOSED REPLACEMENT FACILITY PROJECT" which included seven proposed votes. Attached to said memorandum was a project description, a map indicating the location of the parcel, five depictions of the proposed replacement facility, and a binder containing the Development Impact Project Agreement and Development Impact Project Plan.

Mr. Gerry Kavanaugh, Assistant Director for Institutional Planning and Development, addressed the Authority and answered the Members' questions.

The following individuals addressed the Authority in support of the project:

Dr. Salvatore Russo, Director of the Shriners Burns Institute, distributed a handout on medical research at the Institute;
Mr. Burton Ravelette, Chairman of the Building Committee;
Mr. Ben Rook, Odell Associates;
Mr. Homer Russell, BRA Assistant Director for Urban Design and Development representing the Boston Civic Design Commission;
Mr. Sam Jabbour, Shriners Volunteer;
Ms. Pat Kartiganer, Shriners employee and Charles River Park resident;
Mr. John Messervy, Director of Planning, Mass. General Hospital;
Mr. Norman Herr, Cambridge Street Resident;
Mr. Joe Nigro, Boston Building Trades;
Ms. Susan Connors, Director of Social Services and resident of the Back Bay;
Mr. Bob Bani, Shriners volunteer and resident of Boston;
Mr. Richard Bernacki, Project Manager, Springfield Shriners Hospital.

The following addressed the Authority in opposition to the project:

Mr. Robert Curry, attorney for Trustees of Hawthorne Place; and
Father Buck of St. Joseph's Church in the West End.

The following letters of support were submitted into the record:

Dr. Colleen Ryan, Mass. General Hospital;
Mr. Vincent Cucchiara, Vice President, Mass. General Hospital;
Mr. Peter Swartz, The Cambridge Street Merchants;
Ms. Patricia M. Lybarger, R.N.; and
A petition from patients and parents of patients of Shriners Burns Institute.

Also submitted into the record was a letter from the Beacon Hill Civic Association which reported hearing the proposed Shriners Hospital presentation.

On motion duly made by Mr. Flaherty and seconded by Mr. Donlan, it was unanimously

VOTED: To amend the Development Plan by adding the following:

- That the trellis and garden be removed from the roof to reduce the overall height of the project;
- That the Shriners will work with the BRA design staff to improve wind conditions in the area through landscaping, canopies, or other architectural elements;
- That the BRA staff work with Shriners to develop a landscaping plan for public property along Cardinal O'Connell Way and Blossom Street to improve the attractiveness and quality of the area; and

FURTHER VOTED: That the BRA design staff work with Shriners and interested community members to address design review issues through the completion of the design review process.

On motion duly made and seconded, it was unanimously

VOTED: That in connection with the Development Impact Project Plan for the Shriners Burns Institute

Replacement Facility, 51 Blossom Street, Boston, presented at a public hearing duly held at the offices of the BRA on April 9, 1992, and after consideration of the evidence presented at the hearing, the BRA finds that said Plan: (1) conforms to the general plan for the City of Boston as a whole; (2) contains nothing that will be injurious to the neighborhood or otherwise detrimental to the public welfare; and (3) does adequately and sufficiently satisfy all other criteria and specifications for a Development Impact Project as set forth in Articles 26A and 26B of the Boston Zoning Code as amended; and

FURTHER VOTED: That pursuant to the provisions of Articles 26A and 26B of the Boston Zoning Code as amended, the BRA hereby approves the Development Impact Project Plan as amended for the Shriners Burns Institute Replacement Facility, 51 Blossom Street, Boston. Said Development Plan is embodied in a written document entitled "Development Impact Project Plan for the Shriners Burns Institute Replacement Facility " dated April 9, 1992, and in a series of schematic drawings listed in Exhibit B of said document; said document and plans shall be on file in the Office of the BRA; and

FURTHER VOTED: That the BRA hereby authorizes the Director (1) to execute, in the name and on behalf of the BRA, (a) a Development Impact Project Agreement, in substantially the form presented to the BRA on this date; and (b) other necessary agreements with the developer of the Shriners Burns Institute Replacement Facility at 51 Blossom Street, Boston; and (2) to certify in the name of the BRA, (a) that plans submitted to the Inspectional Services

Commissioner in connection with said project are in conformity with said Development Impact Project Plan; and (b) that the developer has entered into an Agreement with the BRA to be responsible for the Housing Contribution and a Jobs Contribution Grant; and

FURTHER VOTED: That the BRA hereby authorizes the Director to petition the Zoning Commission to establish Parcel 8 of the West End Project Area as an urban renewal area special purpose overlay district; and

FURTHER VOTED: That in reference to the Zoning Board of Appeal petition for 51 Blossom Street, in an H-3 zoning district, brought by the Shriners Hospital for Crippled Children for the BRA recommends approval of the conditional use permits, variances and IPOD permit or, alternatively, exceptions required in connection with the Project, with the proviso that plans are submitted to the BRA staff for design review approval to ensure that the plans are consistent with the plans previously reviewed by the BRA and with the Development Impact Project Plan, provided that the final design review approval shall not be granted prior to the execution of a Transportation Access Plan Agreement, and a Boston Resident Construction Employment Plan, a Memorandum of Understanding, a First Source Agreement, and other necessary agreements with the Mayor's Office of Jobs and Community Services. Further, the BRA authorizes the Director to certify to the Board of Appeal that the petition and the requested conditional use permits, variances and IPOD permit or, alternatively, exceptions required in connection with the Project are consistent with the West End

Land Assembly and Redevelopment Plan and the previously approved development plans and Development Impact Project Plan for the Project; and

FURTHER VOTED: That the BRA hereby authorizes the Director to execute, in the name and on behalf of the BRA, an Adequacy Determination with respect to the Final Project Impact Report for the Shriners Replacement Facility Project, 51 Blossom Street, Boston, upon completion of the review by the BRA of such Final Project Impact Report for said Project; and

FURTHER VOTED: That the BRA hereby authorizes the Director to issue a Certificate of Completion to the Shriners Hospital for Crippled Children for the original improvements to Parcel 8 in the West End Project Area with the proviso that a new Certificate of Completion will be required upon completion of the Replacement Facility; and the BRA further authorizes the Director to execute an amendment to the Sales Contract for the West End Project Area, entered into March 30, 1964, including such terms and conditions as the Director deems appropriate and in the best interest of the BRA.

The aforementioned Development Impact Project Agreement and Plan are incorporated in the Minutes of this meeting and filed in the Document Book of the Authority as Document No. 5477.

II. General Information

II. GENERAL INFORMATION

1.0 APPLICANT INFORMATION

1.1 Development Team

Owner/Developer:	Shriners Hospitals for Crippled Children 51 Blossom Street Boston, MA 02214
Owner's Representative:	Burton E. Ravellette, Jr. Chairman of Building & Equipment Shriners Hospitals for Crippled Children 1706 West 34th Street Pine Bluff, Arkansas 71603
Attorney:	Choate Hall & Stewart 53 State Street Boston, MA (617) 227-5020 Eric Wodlinger, Esquire
Architects/ Engineers Interior Designers & Landscape Architects:	Odell Associates, Inc. 129 West Trade Street Charlotte, NC 28202 (704) 377-5941 Benjamin T. Rook, AIA John W. Walters, AIA
Environmental and Transportation Consultants:	HMM Associates, Inc. 196 Baker Avenue Concord, MA 01742 (508) 371-4000 Mitchell L. Fischman, AICP Barry S. Porter, AICP Cindy Schlessinger
Traffic Engineers:	H.W. Moore Associates, Inc. 112 Shawmut Avenue Boston, MA 02118 (617) 357-8145 James Noyes

Wind Consultant:
Frank Durgin
c/o Wright Brother Wind Tunnel
Building 17-110
M.I.T.
Cambridge, MA 02139
(617) 253-2270

Geotechnical Engineers:
McPhail Associates, Inc.
30 Norfolk Street
Cambridge, MA
(617) 868-1420
Robert Hoyler

Surveyors:
Cullinan Engineering Co., Inc.
145 South Street
Suite 400
Boston, MA 02111
(617) 423-3912
Donald G. Rosa, PLS

Construction Consultants:
Barton Mallow Company
516 Carew Street
Springfield, MA 01104
(413) 735-1393
Richard Bernacki

21E Consultants:
Hidell-Eyster Technical Services
195 Whiting Street
Hingham, MA 02043
Amy McElroy

Structural Engineers:
LeMessurier Consultants, Inc.
1033 Massachusetts Avenue
Cambridge, MA 02138
(617) 868-1200
William LeMessurier
Mysore Rarindra

2.0 LEGAL INFORMATION

2.1 Legal Actions Pending Concerning the Proposed Project

None

2.2 Evidence of Site Control Over the Project Area

The Shriner's Hospital for Crippled Children, a Massachusetts charitable corporation, is the owner of the fee in the premises now numbered as 51 Blossom Street by virtue of a deed from the Boston Redevelopment Authority dated December 29, 1964, recorded at Book 7916, Page 518 in the Suffolk County Registry and Deeds and registered as Document No. 270117 on Certificate of Title No. 73490 and now memorialized by Transfer Certficate of Title No. 73490 in the Suffolk Registry District of the Land Court.

2.3 Evidence of Public Easements

Pursuant to the aforementioned deed and as shown on the plan entitled "Plan of Land in Boston, Parcel 8 of the West End Land Assembly and Redevelopment Plan" dated September 10, 1963, prepared by J.L. Hayden Associates, Inc. (see Figure II-2.1), 17,570 square feet of land as shown on said plan are subject to easements in favor of the City of Boston for highway purposes in Blossom Street and William Cardinal O'Connell Way. The area unburdened by said easements consists of 39,825 feet. The premises also enjoy the benefit of an easement granted by the Roman Catholic Archbishop of Boston for all purposes for which ways are commonly used, in common with the grantor in a portion of the driveway at the northeasterly boundary of the premises. Said easement is recorded at book 7591, Page 302 in the Suffolk Registry of Deeds.

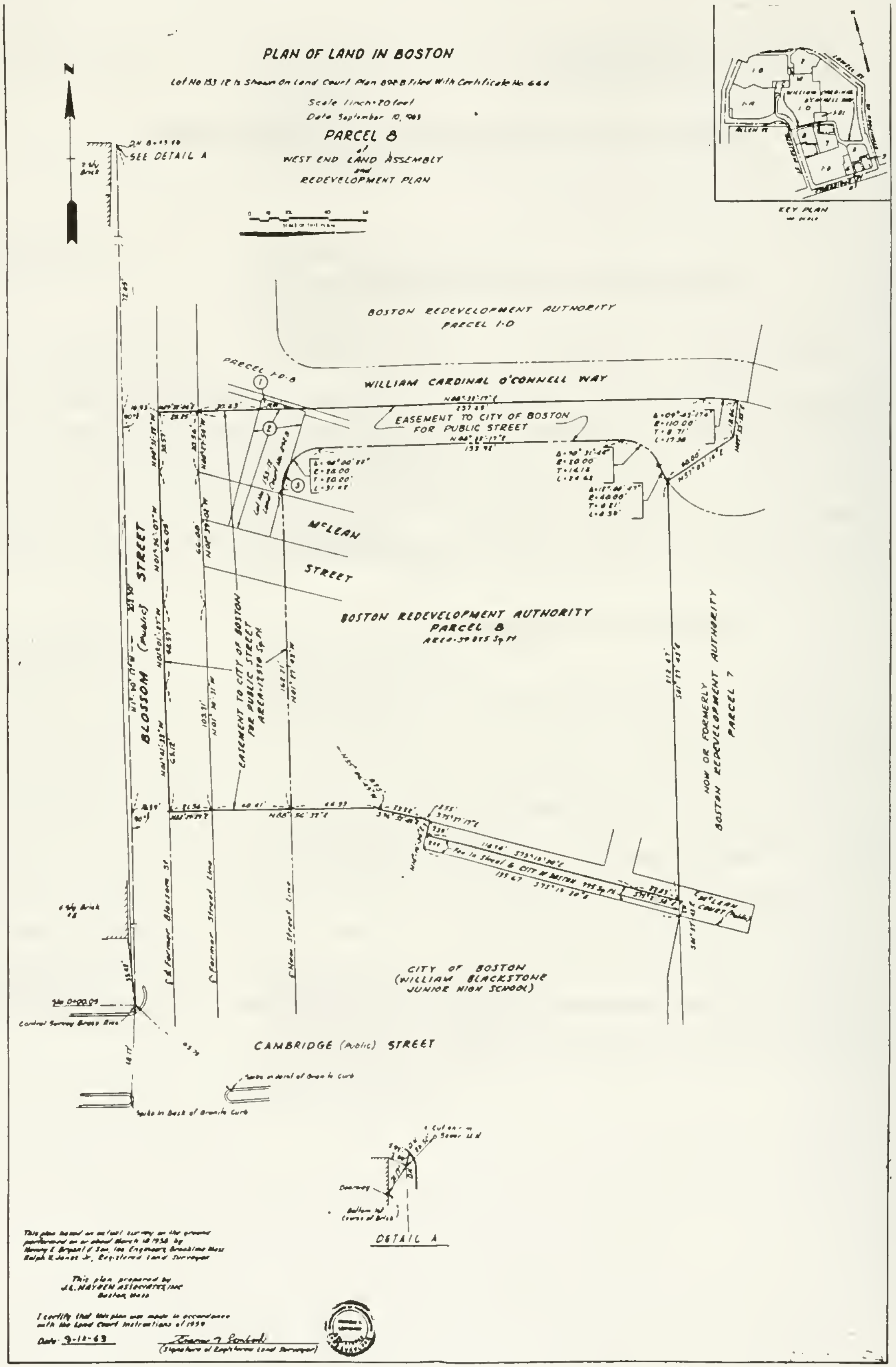
PLAN OF LAND IN BOSTON
Lot No 153 IE Is Shown On Land Court Plan 898 B Filed With Certificate No 664
Scale 1 inch = 20 feet
Date September 10, 1963
PARCEL 8
of
WEST END LAND ASSEMBLY
and
REDEVELOPMENT PLAN
N
SEE DETAIL A
KEY PLAN
BOSTON REDEVELOPMENT AUTHORITY
PARCEL 1-D
PARCEL 1-D-B
WILLIAM CARDINAL O'CONNELL WAY
EASEMENT TO CITY OF BOSTON
FOR PUBLIC STREET
McLEAN
STREET
BLOSSOM (Public) STREET
BOSTON REDEVELOPMENT AUTHORITY
PARCEL 8
EASEMENT TO CITY OF BOSTON
FOR PUBLIC STREET
NOW OR FORMERLY
BOSTON REDEVELOPMENT AUTHORITY
PARCEL 7
McLEAN COURT (Public)
℄ Former Blossom St
℄ Former Street Line
℄ New Street Line
CITY OF BOSTON
(WILLIAM BLACKSTONE
JUNIOR HIGH SCHOOL)
CAMBRIDGE (Public) STREET
Control Survey Brass Disc
Spike in Back of Granite Curb
DETAIL A
Doorway
This plan based on actual survey on the ground
performed on or about March 18 1958 by
Henry F. Bryant & Son, Inc Engineers Brookline Mass
Ralph K. Jones Jr, Registered Land Surveyor
This plan prepared by
J.L. HAYDEN ASSOCIATES INC
Boston Mass
I certify that this plan was made in accordance
with the Land Court Instructions of 1959
Date 9-11-63
(Signature of Registered Land Surveyor)

FIGURE II-2.1
PLAN OF LAND

3.0 FINANCIAL INFORMATION

(a) Land costs. The deed recites a consideration of $53,763.75, or $1.35 per square foot for the 39,825 square feet conveyed unburdened by street easements to the City of Boston.

(b) Since the project will be financed by the owner and used by the owner rather than leased to any tenants, and because the property will be owned and operated by a non-profit, charitable corporation soley for its charitable purposes of medical treatment and research, much of the conventional financial information regarding such matters as sources of debt and equity, measures of return, schedules or rent, debt service, etc. have no application.

(c) A proposed project budget is set out at Table II-3.1.

(d) Linkage calculations for housing and jobs are set out in Section II-5.3.

TABLE II-3.1
PROJECT BUDGET
SHRINERS REPLACEMENT FACILITY

JANUARY 3, 1991

Construction Contract	$37,550,000
Fixed Equipment NIC	0
Group II and III Medical Equipment, Furnishings and Graphics	3,075,000
Site and Soil Survey	160,000
Architect and Engineering Costs	2,440,750
Planning and Development	265,000
Owner's Contingency	1,250,000
Other Costs	360,000
TOTAL PROJECTED BUDGET	$45,100,750

4.0 PROJECT AREA

Address/Location: 52 Blossom Street, Boston, Massachusetts

The site is bounded by William Cardinal O'Connell Way to the north, Blossom Street to the west, a driveway and parking area serving Regina Cleri (elderly priest's housing) to the east and a parking area serving the Blackstone (elderly housing) to the south. The facilities of Massachusetts General Hospital lie directly across Blossom Street including the Wellman Research Building, the Edwards Research Building and Bartlett Hall. Charles River Park (high rise residential) lies across William Cardinal O'Connell Way directly to the north.

5.0 PUBLIC BENEFITS

5.1 Construction Jobs/Permanent Jobs

It is anticipated that the construction of the Shriner's project will require an estimated average daily work force of approximately 200 workers during the peak periods of construction. In addition, the project will result in a net increase of approximately 50 researchers and 12 full-time permanent employees. SHCC will submit a Boston Residents Construction Employment Plan for the project to the Mayor's Office of Jobs and Community Services.

5.2 Linkage

The Shriners Hospital for Crippled Children has agreed to make linkage payments pursuant to Article 26 and 26B of the Boston Zoning Code. The Hospital expects that the gross floor area subject to the linkage requirements will be slightly less than 100,000 square feet. This should yield $498,590 for a housing contribution grant to the Neighborhood Housing Trust and $99,718 as a jobs contribution grant to the Neighborhood Jobs Trust.

5.3 Other Public Benefits (Including Medical Benefits)

The Hospital has a well recognized program of medical and biological research which occupied approximately 21,786 square feet in the existing structure. Research conducted by the Shriners Hospital has given rise to such lifesaving developments as artificial skin and treatment modalities for burn victims which have saved lives even with 90 percent of the body burned (when the Shriners Hospital began its work in the 1960's, burn victims with burns over 50 percent of their bodies rarely survived). The progress and success of Shriners medical research has led Shriners to increase medical research. The new Hospital will have approximately 50 percent more space devoted to medical research, with a projected gross floor area of 30,000 square feet. The medical spinoffs of Shriners research, such as clinical trials, include a local company which is now growing cultured skin products and employing approximately 85 persons.

5.4 Medical Treatment

In 1991, Shriners treated approximately 618 inpatients and approximately 3,048 outpatients at its Boston facility. Every one of these patients was treated for free. Although the value of these medical services is difficult to calculate, the cost of providing these services and the associated medical research is apparent in Shriner's 1990 expense budget of approximately $11,970,000.

5.5 Construction and Equipment Budget

As indicated in Table II-2.1, approximately $45 million dollars will be spent for the construction and fitting out of the Hospital and research facilities.

6.0 REGULATORY CONTROLS AND PERMITS

The New Facilities' site at 51 Blossom Street is located in an H-3 Zoning District, a Restricted Parking District, and Subdistrict M of the Downtown Interim Planning Overlay District ("IPOD"). Within the H-3 District, there is no limit on height, but the IPOD has an as-of-right height limit of 125 feet and an enhanced height limit of 155 feet. (The West End Urban Renewal Plan also specified a height limit of 155 feet for this site.) The Zoning Commission, on June 12, 1992, enacted a zoning amendment designating the site as a urban renewal overlay district ("U" District) within the West End Urban Renewal Area (see Appendix F) Zoning relief has been sought for a variety of dimensional features and hospital related uses. Because a "U" District designation has been adopted by the Zoning Commission for Shriners site, the zoning relief requested has taken the form of exceptions. The Boston Board of Appeal unanimously approved the requested exceptions on August 4, 1992.

After three hearings and a sub-committee meeting, the Boston Civic Design Commission unanimously approved the building design on April 7, 1992.

The Board of the Boston Redevelopment Authority unanimously approved the building plans and the requested zoning relief and zoning amendment by vote on April 9, 1992 (see Section I-4.3).

7.0 CHRONOLOGY OF MEETINGS

NO.	DATE	NON-PROJECT PROPONENT ATTENDEES	SUMMARY
1.	November 7, 1990	Massachusetts General Hospital	Preliminary discussions with Massachusetts General Hospital.
2.	April 8, 1991	Rappaport and Rakov	Presentation of "Conceptual Analysis" book, received comments regarding View & Height.
3.	April 22, 1991	Blackstone Apartments, Boston Redevelopment Authority	Presentation of "Conceptual Analysis" book to introduce concept of new facility.
4.	April 22, 1991	St. Josephs, Regina Cleri, Boston Redevelopment Authority	Presentation of "Conceptual Analysis" book to introduce concept of new facility.
5.	April 22, 1991	Hawthorne Place, Boston Redevelopment Authority	Presentation of "Conceptual Analysis" book to introduce concept of new facility.
6.	May 17, 1991	St. Joseph's	Received comments on "Conceptual Analysis" as presented on April 22, 1991.
7.	May 17, 1991	Hawthorne Place	Received comments on "Conceptual Analysis" as presented on April 22, 1991.
8.	May 17, 1991	Blackstone Apartments	Received comments on "Conceptual Analysis" as presented on April 22, 1991.
9.	May 23, 1991	Community Meeting Convened by BRA	Formal presentation of concept.
10.	May 28, 1991	Community Meeting	MEPA hearing to receive comments on Environmental Notification Form.
11.	July 15, 1991	Community Meeting	Presentation of revised building, "17 Issues" of design change presented in response to comments received at May 23, 1991 meeting.
12.	September 4, 1991	Beacon Hill Civic Association, Boston Redevelopment Authority	Formal presentation to Beacon Hill neighborhood.
13.	December 3, 1991	Massachusetts General Hospital	Formal presentation.
14.	December 3, 1991	Boston Civic Design Commission, Boston Redevelopment Authority, Hawthorne Place	Presentation of building design.
15.	December 17, 1991	Boston Civic Design, Commission, Boston Redevelopment Authority, Hawthorne Place	Continuing discussion at BCDC.

NO.	DATE	NON-PROJECT PROPONENT ATTENDEES	SUMMARY
16.	January 7, 1992	Boston Civic Design Commission, Boston Redevelopment Authority, Hawthorne Place	Sub-committee report to Boston Civic Design Commission.
17.	January 23, 1992	Hawthorne Place, Boston Redevelopment Authority	Discussions of parking/traffic and height/mass.
18.	February 5, 1992	Hawthorne Place, Boston Redevelopment Authority, Hawthorne Place's Transportation Consultant	Traffic issues discussed by Hawthorne Place's Traffic Consultant and Shriners Traffic Consultant.
19.	February 6, 1992	Boston Redevelopment Authority, Hawthorne Place	Design Review.
20.	March 24, 1992	Charles River Properties	Design and parking review.
21.	April 7, 1992	Boston Civic Design Commission	Project Review and approval by Boston Civic Design Commission.
22.	April 9, 1992	Boston Redevelopment Authority, Hawthorne Place, St. Joseph's Church	Boston Redevelopment Authority Board public hearing and approval by Boston Redevelopment Authority Board.
23.	April 27, 1992	Zoning Commission, Hawthorne Place, St. Joseph's Church	Zoning Commission hearing on proposed "U" Designation.
24.	May 6, 1992	Hawthorne Place's Attorney, Hawthorne Place, Father Bucke	Discuss project history and current status, schedule meeting to review building design.
25.	May 7, 1992	Hawthrone Place's Architect	Review building design and concepts suggested by Hawthorne Place's architect.
26.	June 4, 1992	Zoning Commission, Hawthorne Place, Archdiocese, St. Joseph's Church	Zoning Commission hearing on proposed "U" Designation.
27.	June 10, 1992	Zoning Commission, Hawthorne Place	Approval of "U" Designation by Zoning Commission.
28.	June 11, 1992	Zoning Commissioners Fondren and Domenech, Hawthorne Place	Review of issues requested by Zoning Commission.
29.	June 25, 1992	Zoning Commissioners Fondren and Domenech, Hawthorne Place's architect	Review building corner options, landscaping and exterior elevation studies.
30.	July 23, 1992	Zoning Commissioners Fondren and Domenech, Hawthorne Place's architect	Present building corner solution, landscape options, and response to Ellenbogen letter (dated July 10, 1992).
31.	August 4, 1992	Board of Appeal Hawthorne Place Charles River Park	Hearing on zoning relief and parking.

II. General Information

II. GENERAL INFORMATION

1.0 APPLICANT INFORMATION

1.1 Development Team

Owner/Developer:	Shriners Hospitals for Crippled Children 51 Blossom Street Boston, MA 02214
Owner's Representative:	Burton E. Ravellette, Jr. Chairman of Building & Equipment Shriners Hospitals for Crippled Children 1706 West 34th Street Pine Bluff, Arkansas 71603
Attorney:	Choate Hall & Stewart 53 State Street Boston, MA (617) 227-5020 Eric Wodlinger, Esquire
Architects/ Engineers Interior Designers & Landscape Architects:	Odell Associates, Inc. 129 West Trade Street Charlotte, NC 28202 (704) 377-5941 Benjamin T. Rook, AIA John W. Walters, AIA
Environmental and Transportation Consultants:	HMM Associates, Inc. 196 Baker Avenue Concord, MA 01742 (508) 371-4000 Mitchell L. Fischman, AICP Barry S. Porter, AICP Cindy Schlessinger
Traffic Engineers:	H.W. Moore Associates, Inc. 112 Shawmut Avenue Boston, MA 02118 (617) 357-8145 James Noyes

Wind Consultant:
Frank Durgin
c/o Wright Brother Wind Tunnel
Building 17-110
M.I.T.
Cambridge, MA 02139
(617) 253-2270

Geotechnical Engineers:
McPhail Associates, Inc.
30 Norfolk Street
Cambridge, MA
(617) 868-1420
Robert Hoyler

Surveyors:
Cullinan Engineering Co., Inc.
145 South Street
Suite 400
Boston, MA 02111
(617) 423-3912
Donald G. Rosa, PLS

Construction Consultants:
Barton Mallow Company
516 Carew Street
Springfield, MA 01104
(413) 735-1393
Richard Bernacki

21E Consultants:
Hidell-Eyster Technical Services
195 Whiting Street
Hingham, MA 02043
Amy McElroy

Structural Engineers:
LeMessurier Consultants, Inc.
1033 Massachusetts Avenue
Cambridge, MA 02138
(617) 868-1200
William LeMessurier
Mysore Rarindra

2.0 LEGAL INFORMATION

2.1 Legal Actions Pending Concerning the Proposed Project

None

2.2 Evidence of Site Control Over the Project Area

The Shriner's Hospital for Crippled Children, a Massachusetts charitable corporation, is the owner of the fee in the premises now numbered as 51 Blossom Street by virtue of a deed from the Boston Redevelopment Authority dated December 29, 1964, recorded at Book 7916, Page 518 in the Suffolk County Registry and Deeds and registered as Document No. 270117 on Certificate of Title No. 73490 and now memorialized by Transfer Certficate of Title No. 73490 in the Suffolk Registry District of the Land Court.

2.3 Evidence of Public Easements

Pursuant to the aforementioned deed and as shown on the plan entitled "Plan of Land in Boston, Parcel 8 of the West End Land Assembly and Redevelopment Plan" dated September 10, 1963, prepared by J.L. Hayden Associates, Inc. (see Figure II-2.1), 17,570 square feet of land as shown on said plan are subject to easements in favor of the City of Boston for highway purposes in Blossom Street and William Cardinal O'Connell Way. The area unburdened by said easements consists of 39,825 feet. The premises also enjoy the benefit of an easement granted by the Roman Catholic Archbishop of Boston for all purposes for which ways are commonly used, in common with the grantor in a portion of the driveway at the northeasterly boundary of the premises. Said easement is recorded at book 7591, Page 302 in the Suffolk Registry of Deeds.

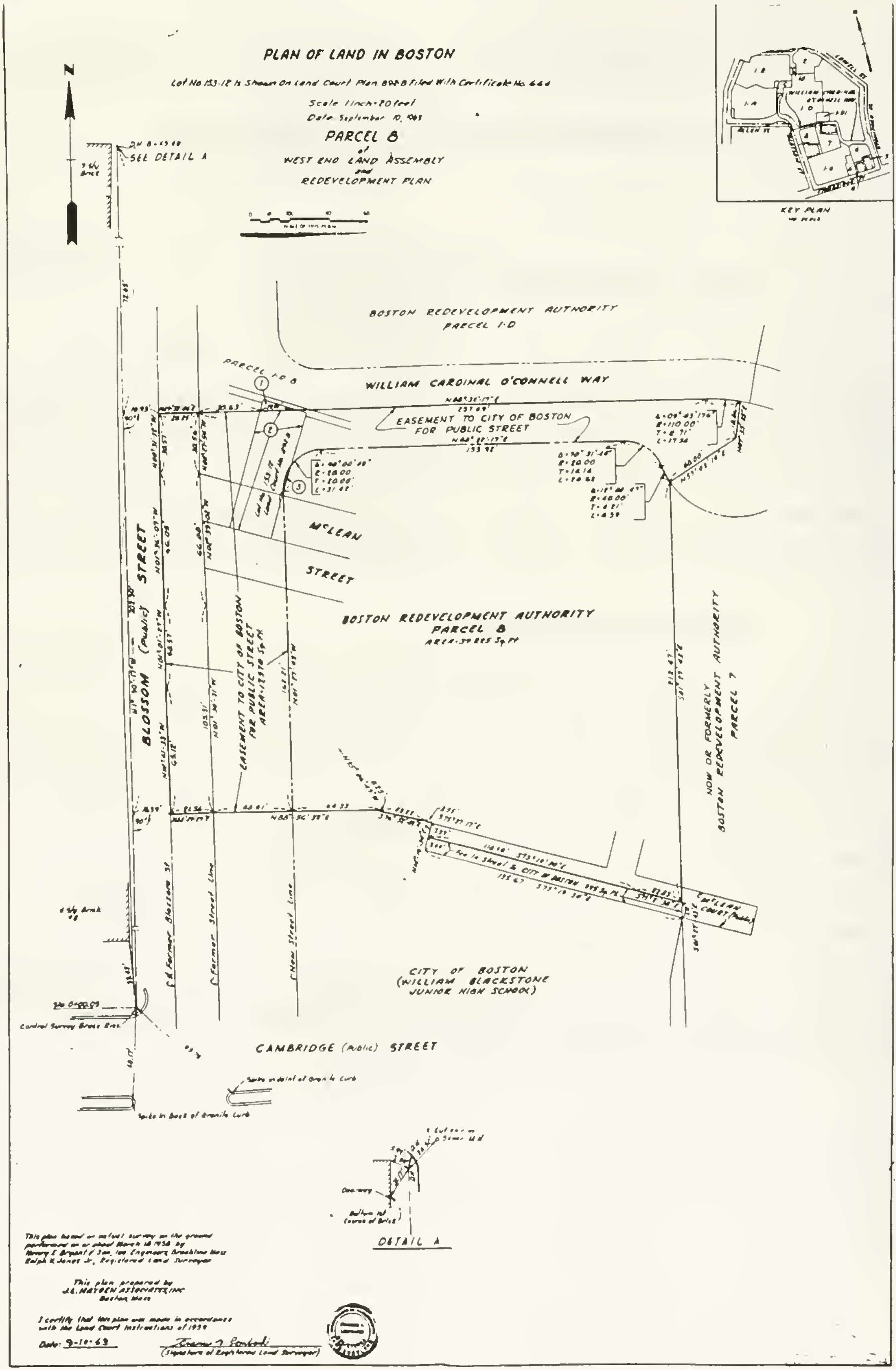
PLAN OF LAND IN BOSTON
Lot No 153-18 Is Shown On Land Court Plan 898 B Filed With Certificate No. 664
Scale 1 inch = 20 feet
Date September 10, 1963
PARCEL 8
of
WEST END LAND ASSEMBLY
and
REDEVELOPMENT PLAN
N
SEE DETAIL A
BOSTON REDEVELOPMENT AUTHORITY
PARCEL 1-D
PARCEL 1-D B
WILLIAM CARDINAL O'CONNELL WAY
EASEMENT TO CITY OF BOSTON
FOR PUBLIC STREET
McLEAN
STREET
BOSTON REDEVELOPMENT AUTHORITY
PARCEL 8
BLOSSOM (Public) STREET
EASEMENT TO CITY OF BOSTON
FOR PUBLIC STREET
NOW OR FORMERLY
BOSTON REDEVELOPMENT AUTHORITY
PARCEL 7
McLEAN COURT (Public)
Former Blossom St
Former Street Line
New Street Line
CITY OF BOSTON
(WILLIAM BLACKSTONE
JUNIOR HIGH SCHOOL)
CAMBRIDGE (Public) STREET
Control Survey Brass Bnd
Spike in Back of Granite Curb
DETAIL A
Bottom of Course of Brick
KEY PLAN
no scale
LOWELL ST
ALLEN ST
CAMBRIDGE ST
WILLIAM CARDINAL O'CONNELL WAY
This plan based on actual survey on the ground performed on or about March 18 1958 by Henry F. Bryant & Son, Inc. Engineers Brookline Mass Ralph K. Jones Jr., Registered Land Surveyor
This plan prepared by J.L. HAYDEN ASSOCIATES, INC. Boston, Mass
I certify that this plan was made in accordance with the Land Court Instructions of 1959
Date: 9-10-63
(Signature of Registered Land Surveyor)

FIGURE II-2.1
PLAN OF LAND

3.0 FINANCIAL INFORMATION

(a) Land costs. The deed recites a consideration of $53,763.75, or $1.35 per square foot for the 39,825 square feet conveyed unburdened by street easements to the City of Boston.

(b) Since the project will be financed by the owner and used by the owner rather than leased to any tenants, and because the property will be owned and operated by a non-profit, charitable corporation soley for its charitable purposes of medical treatment and research, much of the conventional financial information regarding such matters as sources of debt and equity, measures of return, schedules or rent, debt service, etc. have no application.

(c) A proposed project budget is set out at Table II-3.1.

(d) Linkage calculations for housing and jobs are set out in Section II-5.3.

TABLE II-3.1
PROJECT BUDGET
SHRINERS REPLACEMENT FACILITY

JANUARY 3, 1991

Construction Contract	$37,550,000
Fixed Equipment NIC	0
Group II and III Medical Equipment, Furnishings and Graphics	3,075,000
Site and Soil Survey	160,000
Architect and Engineering Costs	2,440,750
Planning and Development	265,000
Owner's Contingency	1,250,000
Other Costs	360,000
TOTAL PROJECTED BUDGET	$45,100,750

4.0 PROJECT AREA

Address/Location: 52 Blossom Street, Boston, Massachusetts

The site is bounded by William Cardinal O'Connell Way to the north, Blossom Street to the west, a driveway and parking area serving Regina Cleri (elderly priest's housing) to the east and a parking area serving the Blackstone (elderly housing) to the south. The facilities of Massachusetts General Hospital lie directly across Blossom Street including the Wellman Research Building, the Edwards Research Building and Bartlett Hall. Charles River Park (high rise residential) lies across William Cardinal O'Connell Way directly to the north.

5.0 PUBLIC BENEFITS

5.1 Construction Jobs/Permanent Jobs

It is anticipated that the construction of the Shriner's project will require an estimated average daily work force of approximately 200 workers during the peak periods of construction. In addition, the project will result in a net increase of approximately 50 researchers and 12 full-time permanent employees. SHCC will submit a Boston Residents Construction Employment Plan for the project to the Mayor's Office of Jobs and Community Services.

5.2 Linkage

The Shriners Hospital for Crippled Children has agreed to make linkage payments pursuant to Article 26 and 26B of the Boston Zoning Code. The Hospital expects that the gross floor area subject to the linkage requirements will be slightly less than 100,000 square feet. This should yield $498,590 for a housing contribution grant to the Neighborhood Housing Trust and $99,718 as a jobs contribution grant to the Neighborhood Jobs Trust.

5.3 Other Public Benefits (Including Medical Benefits)

The Hospital has a well recognized program of medical and biological research which occupied approximately 21,786 square feet in the existing structure. Research conducted by the Shriners Hospital has given rise to such lifesaving developments as artificial skin and treatment modalities for burn victims which have saved lives even with 90 percent of the body burned (when the Shriners Hospital began its work in the 1960's, burn victims with burns over 50 percent of their bodies rarely survived). The progress and success of Shriners medical research has led Shriners to increase medical research. The new Hospital will have approximately 50 percent more space devoted to medical research, with a projected gross floor area of 30,000 square feet. The medical spinoffs of Shriners research, such as clinical trials, include a local company which is now growing cultured skin products and employing approximately 85 persons.

5.4 Medical Treatment

In 1991, Shriners treated approximately 618 inpatients and approximately 3,048 outpatients at its Boston facility. Every one of these patients was treated for free. Although the value of these medical services is difficult to calculate, the cost of providing these services and the associated medical research is apparent in Shriner's 1990 expense budget of approximately $11,970,000.

5.5 Construction and Equipment Budget

As indicated in Table II-2.1, approximately $45 million dollars will be spent for the construction and fitting out of the Hospital and research facilities.

6.0 REGULATORY CONTROLS AND PERMITS

The New Facilities' site at 51 Blossom Street is located in an H-3 Zoning District, a Restricted Parking District, and Subdistrict M of the Downtown Interim Planning Overlay District ("IPOD"). Within the H-3 District, there is no limit on height, but the IPOD has an as-of-right height limit of 125 feet and an enhanced height limit of 155 feet. (The West End Urban Renewal Plan also specified a height limit of 155 feet for this site.) The Zoning Commission, on June 12, 1992, enacted a zoning amendment designating the site as a urban renewal overlay district ("U" District) within the West End Urban Renewal Area (see Appendix F). Zoning relief has been sought for a variety of dimensional features and hospital related uses. Because a "U" District designation has been adopted by the Zoning Commission for Shriners site, the zoning relief requested has taken the form of exceptions. The Boston Board of Appeal unanimously approved the requested exceptions on August 4, 1992.

After three hearings and a sub-committee meeting, the Boston Civic Design Commission unanimously approved the building design on April 7, 1992.

The Board of the Boston Redevelopment Authority unanimously approved the building plans and the requested zoning relief and zoning amendment by vote on April 9, 1992 (see Section I-4.3).

7.0 CHRONOLOGY OF MEETINGS

NO.	DATE	NON-PROJECT PROPONENT ATTENDEES	SUMMARY
1.	November 7, 1990	Massachusetts General Hospital	Preliminary discussions with Massachusetts General Hospital.
2.	April 8, 1991	Rappaport and Rakov	Presentation of "Conceptual Analysis" book, received comments regarding View & Height.
3.	April 22, 1991	Blackstone Apartments, Boston Redevelopment Authority	Presentation of "Conceptual Analysis" book to introduce concept of new facility.
4.	April 22, 1991	St. Josephs, Regina Cleri, Boston Redevelopment Authority	Presentation of "Conceptual Analysis" book to introduce concept of new facility.
5.	April 22, 1991	Hawthorne Place, Boston Redevelopment Authority	Presentation of "Conceptual Analysis" book to introduce concept of new facility.
6.	May 17, 1991	St. Joseph's	Received comments on "Conceptual Analysis" as presented on April 22, 1991.
7.	May 17, 1991	Hawthorne Place	Received comments on "Conceptual Analysis" as presented on April 22, 1991.
8.	May 17, 1991	Blackstone Apartments	Received comments on "Conceptual Analysis" as presented on April 22, 1991.
9.	May 23, 1991	Community Meeting Convened by BRA	Formal presentation of concept.
10.	May 28, 1991	Community Meeting	MEPA hearing to receive comments on Environmental Notification Form.
11.	July 15, 1991	Community Meeting	Presentation of revised building, "17 Issues" of design change presented in response to comments received at May 23, 1991 meeting.
12.	September 4, 1991	Beacon Hill Civic Association, Boston Redevelopment Authority	Formal presentation to Beacon Hill neighborhood.
13.	December 3, 1991	Massachusetts General Hospital	Formal presentation.
14.	December 3, 1991	Boston Civic Design Commission, Boston Redevelopment Authority, Hawthorne Place	Presentation of building design.
15.	December 17, 1991	Boston Civic Design, Commission, Boston Redevelopment Authority, Hawthorne Place	Continuing discussion at BCDC.

NO.	DATE	NON-PROJECT PROPONENT ATTENDEES	SUMMARY
16.	January 7, 1992	Boston Civic Design Commission, Boston Redevelopment Authority, Hawthorne Place	Sub-committee report to Boston Civic Design Commission.
17.	January 23, 1992	Hawthorne Place, Boston Redevelopment Authority	Discussions of parking/traffic and height/mass.
18.	February 5, 1992	Hawthorne Place, Boston Redevelopment Authority, Hawthorne Place's Transportation Consultant	Traffic issues discussed by Hawthorne Place's Traffic Consultant and Shriners Traffic Consultant.
19.	February 6, 1992	Boston Redevelopment Authority, Hawthorne Place	Design Review.
20.	March 24, 1992	Charles River Properties	Design and parking review.
21.	April 7, 1992	Boston Civic Design Commission	Project Review and approval by Boston Civic Design Commission.
22.	April 9, 1992	Boston Redevelopment Authority, Hawthorne Place, St. Joseph's Church	Boston Redevelopment Authority Board public hearing and approval by Boston Redevelopment Authority Board.
23.	April 27, 1992	Zoning Commission, Hawthorne Place, St. Joseph's Church	Zoning Commission hearing on proposed "U" Designation.
24.	May 6, 1992	Hawthorne Place's Attorney, Hawthorne Place, Father Bucke	Discuss project history and current status, schedule meeting to review building design.
25.	May 7, 1992	Hawthrone Place's Architect	Review building design and concepts suggested by Hawthorne Place's architect.
26.	June 4, 1992	Zoning Commission, Hawthorne Place, Archdiocese, St. Joseph's Church	Zoning Commission hearing on proposed "U" Designation.
27.	June 10, 1992	Zoning Commission, Hawthorne Place	Approval of "U" Designation by Zoning Commission.
28.	June 11, 1992	Zoning Commissioners Fondren and Domenech, Hawthorne Place	Review of issues requested by Zoning Commission.
29.	June 25, 1992	Zoning Commissioners Fondren and Domenech, Hawthorne Place's architect	Review building corner options, landscaping and exterior elevation studies.
30.	July 23, 1992	Zoning Commissioners Fondren and Domenech, Hawthorne Place's architect	Present building corner solution, landscape options, and response to Ellenbogen letter (dated July 10, 1992).
31.	August 4, 1992	Board of Appeal Hawthorne Place Charles River Park	Hearing on zoning relief and parking.

III. Updated Project Description & Alternatives to the Project

III. UPDATED PROJECT DESCRIPTION AND ALTERNATIVES TO THE PROJECT

1.0 PHYSICAL CHARACTERISTICS OF THE SITE AND SURROUNDINGS

1.1 The Site and Its Characteristics

The proposed Shriners Burns Institute Replacement Facility is located on the same site as the existing facility. The block is bounded on the north by William Cardinal O'Connell Way and on the west by Blossom Street. Adjacent facilities include St. Joseph's Catholic Church and Regina Cleri (elderly priest's housing) to the east, the Blackstone Apartments (elderly housing) to the south, Charles River Park (high rise residential buildings) to the north, and Massachusetts General Hospital to the west. The facilities of Massachusetts General Hospital directly across Blossom Street from the site include the Wellman Research Building, the Edwards Research Building and Bartlett Hall (see Figure I-3.1 in Section I).

The site was purchased by Shriners from the BRA in 1964. Its immediate proximity to MGH has allowed Shriners to maintain a physical link (through an existing tunnel) with the hospital, which is critical for the care of patients at both facilities. The site is approximately 0.9 acres (39,825 sf)* and contains a building of four stories and 80,000 gross square feet. Parking on the site is limited to three spaces to the rear of the existing facility and is accessed from the rear driveway off William Cardinal O'Connell Way. No interior parking exists within the building. An additional 104 spaces are owned at the adjacent Hawthorne Place Garage and 20 spaces are leased, half at the Charles River Park Garage on Lomasney Way and half at the Hawthorne Place Garage.

The site is within the City of Boston's Subdistrict M of Article 27D's Downtown Interim Planning Overlay District (IPOD), which is a medium growth area. Cambridge Street, which is within 500 feet of the site is designated by the BRA as a "Special Study Area" as it "forms the commercial seam between historic Beacon Hill and the West End Urban Renewal Area" in which Shriners is located. A zoning amendment adopted June 12, 1992 places the site within an urban renewal overlay district.

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* Shriners owns an additional 17,570 sf of land subject to public street easements.

1.2 Abutting Land Uses

Abutters to the Shriners Burns Institute site include on the east, St. Joseph's Church and the Regina Cleri Housing Project, providing housing for retired priests. On the south, the Blackstone Apartments provides housing for low income and elderly residents. On the west, medical research facilities belonging to the Massachusetts General Hospital and the main hospital campus are both separated from the project site by Blossom Street. On the north, the Hawthorne Place Condominiums and related portions of the Charles River Park development are separated from the project by William Cardinal O'Connell Way.

2.0 ALTERNATIVES CONSIDERED

Some of the DEIR/DPIR comment letters suggest that Shriners should consider alternatives. Certainly, the project described in the DEIR/DPIR differs markedly from that described in the ENF. The 17 major changes detailed in DEIR/DPIR (pages VI-17-19) are notable alterations to the ENF project arising from the input of the abutters and the BRA.

The DEIR/DPIR Project Description (pages III-3 through III-7) discusses modifications made to the project based on a series of neighborhood meetings following the PNF submission in March 1991. Reductions in height, building footprint, and massing led to greater setbacks along Blossom Street, William Cardinal O'Connell Way, and the rear driveway in the revised proposal which is evaluated in the DEIR/DPIR. The DEIR/DPIR project further mitigated impacts through new street tree plantings and improved rooftop treatment. Other improvements and modifications were identified in the DEIR/DPIR, pages III-5 through III-7, and VI-3 through VI-18.

While the BRA Scoping Determination does not reference any specific Build alternatives to be evaluated, all DEIR/DPIR impact analyses utilized the No-Build condition as a means to establish a datum point against which to compare impacts. In addition, the Urban Design Component (DEIR/DPIR, Section VI) discussed alternative designs and locations for the proposed project.

In addition, Shriners explored several alternative sites. One such site, next to Spaulding Rehabilitation Hospital, became unavailable due to Spaulding's own expansion plans and the need for the site by various public agencies and the Central Artery project. Another possibility, on Lomasney Way, proved to be too distant from MGH for patient treatment needs. Other unsuccessful discussions centered around the former Charles Street Jail site, which might have proven desirable, but is the subject of new planning by MGH to meet its own needs, and was the subject of a land swap which only MGH could make.

After investigating these sites and their problems, SHCC began to pursue options for expansion on their own property. Early studies included the following:

- Scheme 1 - Adding three levels to the existing building at the northwest corner (see Figures III-2.1 and III-2.2);

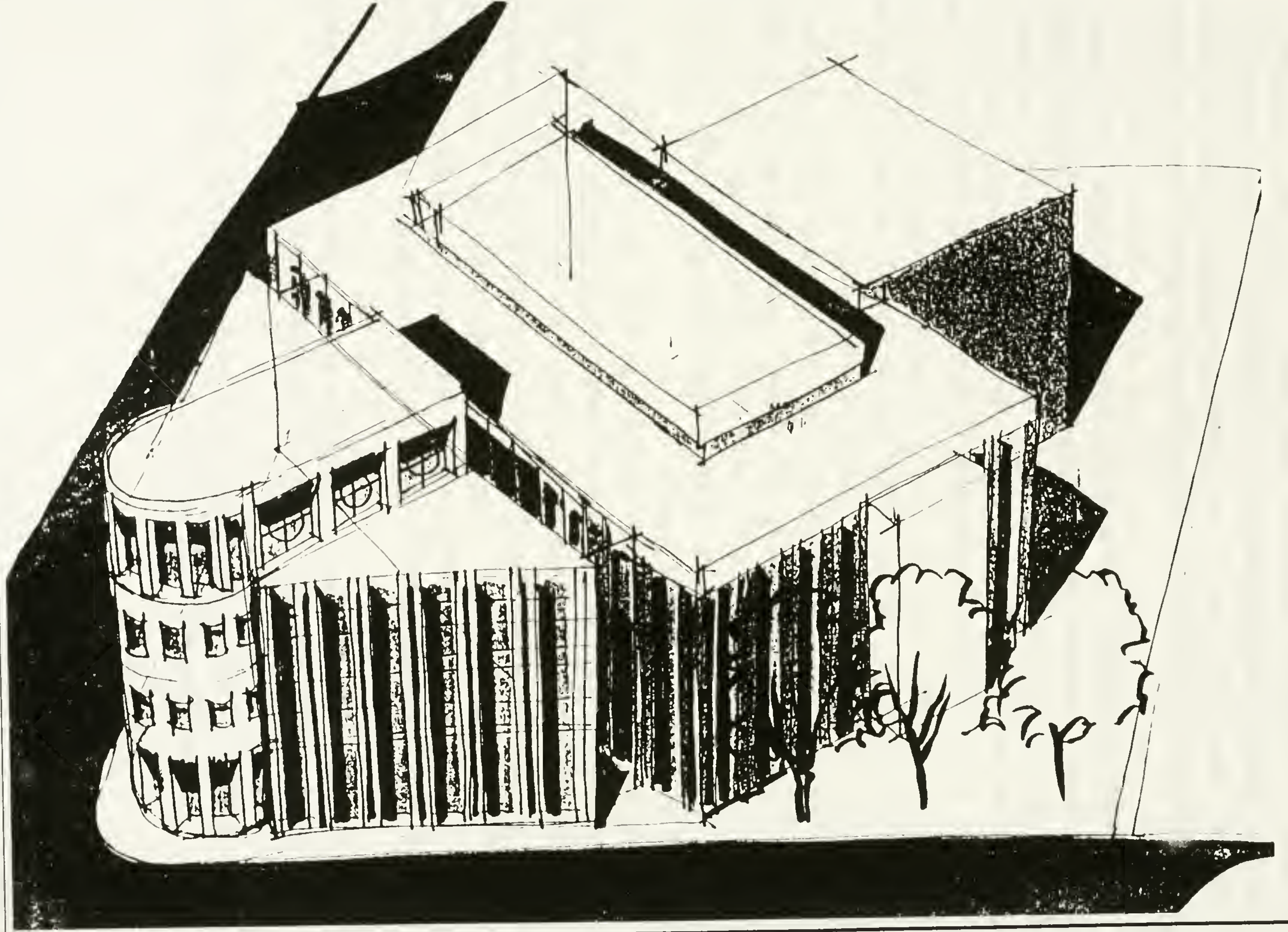


FIGURE III-2.1
SKETCH OF SCHEME 1 ADDING THREE LEVELS TO THE
EXISTING BUILDING AT THE NORTHWEST CORNER

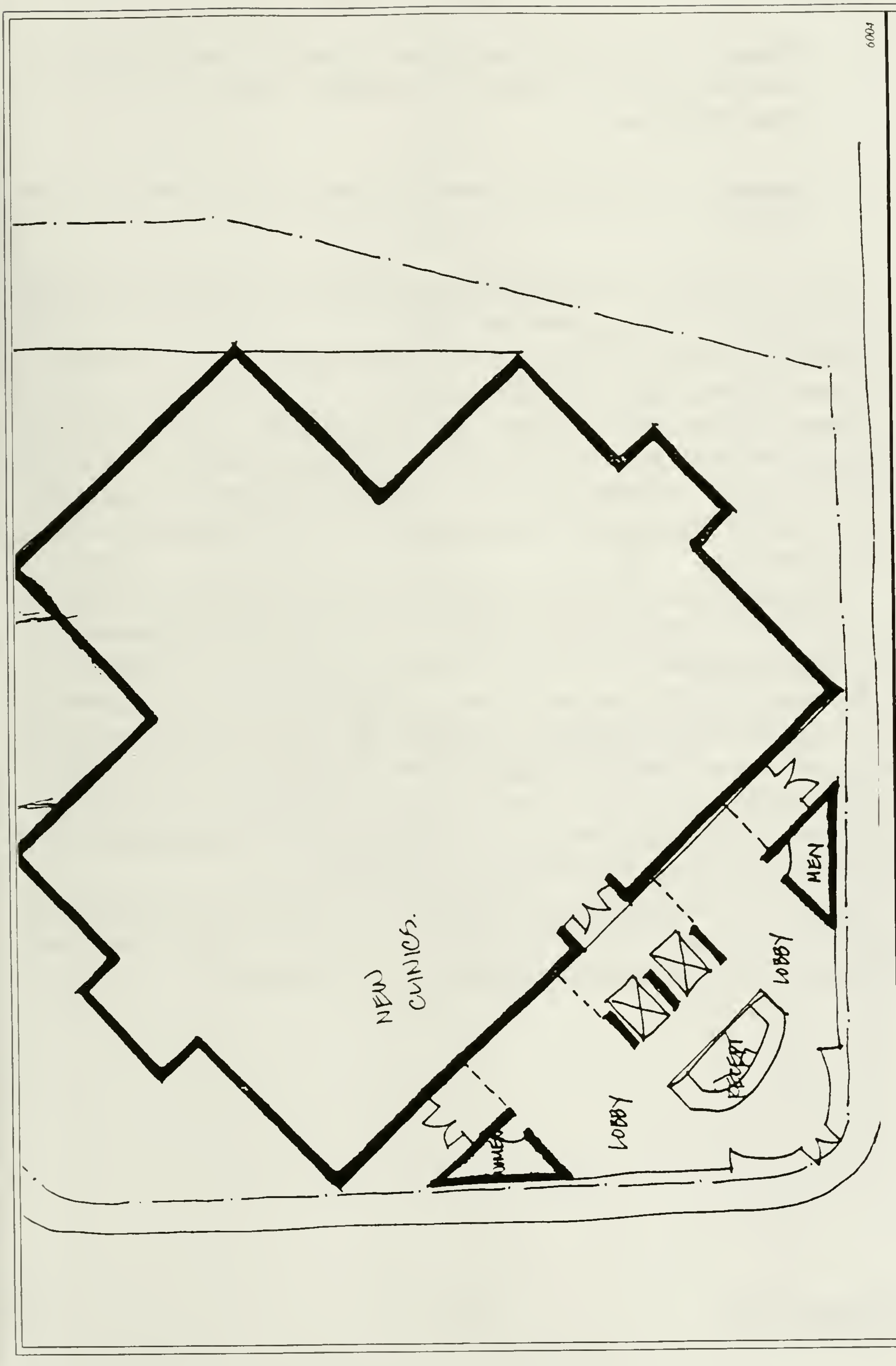


FIGURE III-2.2
SITE PLAN OF SCHEME 1

- o Scheme 2 - Adding extra floors of a size to match the existing building (with trusses to support new floors) with new elevators and stairs at corners (see Figure III-2.3); and

- o Scheme 3 - The scheme as presented in the PNF (see Figures III-2.4 and III-2.5).

Scheme 1 did not provide enough new area (the addition of 16,500 sf for a total facility of 96,500 sf) to adequately update the facility.

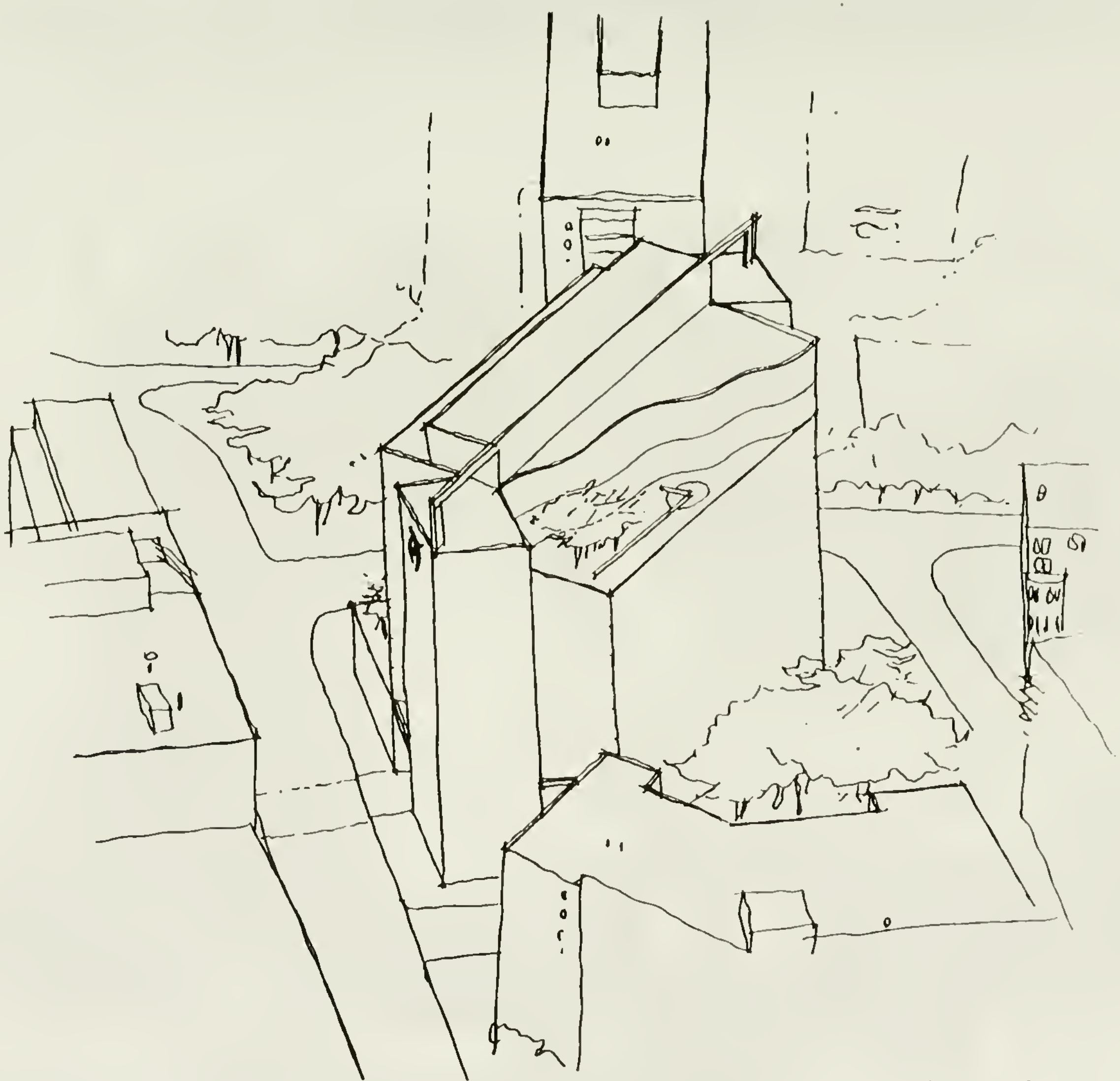
Scheme 2 provided proper area, but the existing floor area was not of sufficient size for department relationships. It also required 11 floors.

Scheme 3 presented the optimal floor area (30,000 sf) for departmental relationships. Five floors above the truss allowed all necessary components to be located in Phase I, requiring no temporary off-site relocations during Phase II construction. Parking was located above-grade in levels below the truss, a more economical and easier to construct alternative.

Neighborhood reaction to Scheme 3, when presented during meetings on April 22, May 17, and May 23, 1991, was negative. A series of design changes in response to the neighborhood input resulted in the revised proposal as presented in the DEIR/DPIR.

The amount of underground parking on the new site will have no effect whatever on the size, height or mass of the building. Even without any parking on-site, the size of those floors above the truss, essential to re-establish the hospital before the old facility is demolished, will define the size and height of the building. The research, administrative, auditorium and parking space which will be built in Phase II below the truss will have no effect upon the size and mass of the building above the truss.

Thus, there is no effective alternative for Shriners to consider without discontinuing the provision of medical service to burn victims in the northeast region of the United States during the construction period; a limitation Shriners can not accept.



SHRINERS HOSPITALS FOR CRIPPLED CHILDREN

BURNS INSTITUTE · BOSTON

6004

FIGURE III-2.3
SCHEME 2: ADDING EXTRA FLOORS OF A SIZE TO MATCH
THE EXISTING BUILDING

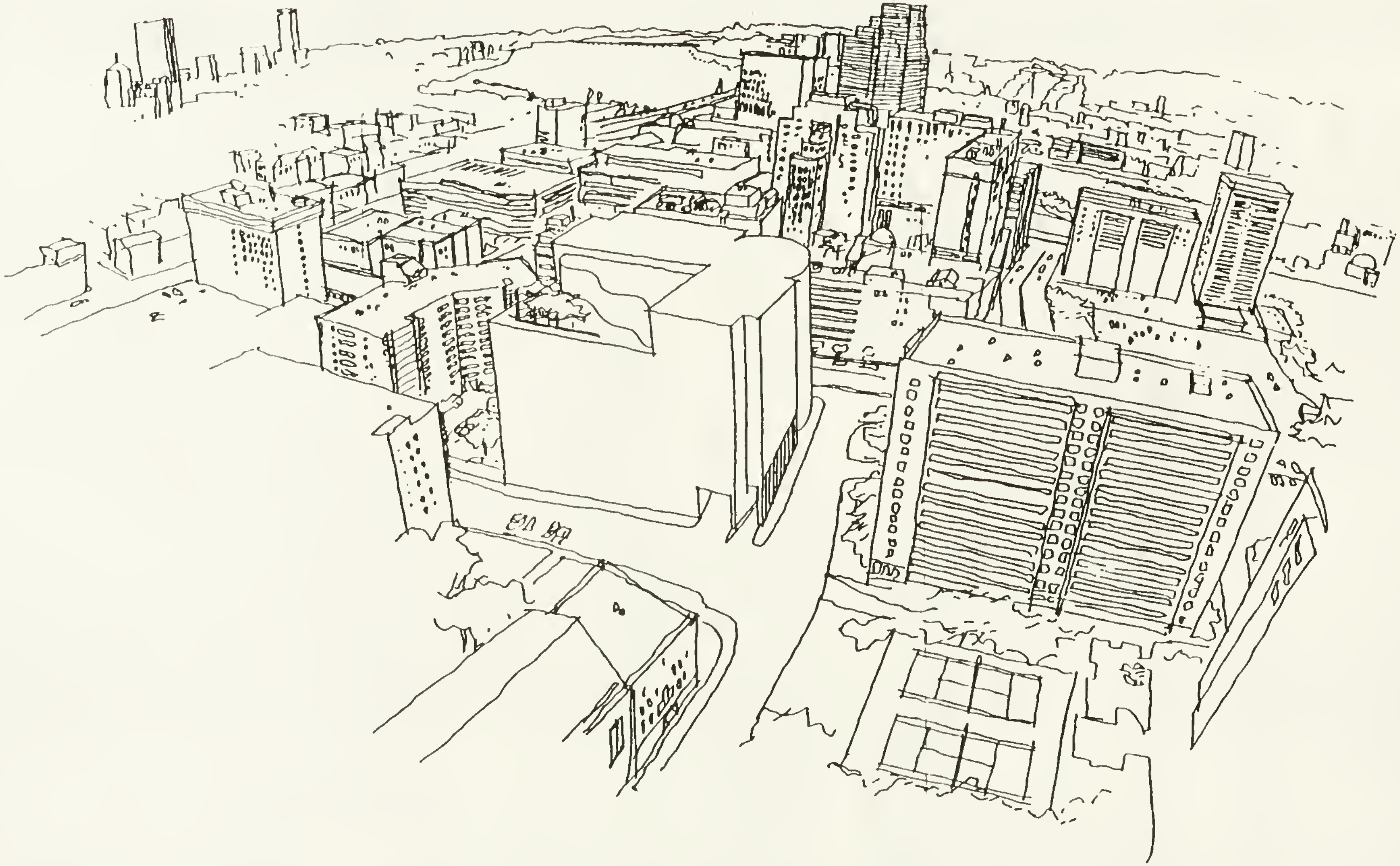


FIGURE III-2.4
PNF SCHEMATIC PROPOSAL, MARCH 1991
SHRINERS REPLACEMENT FACILITY

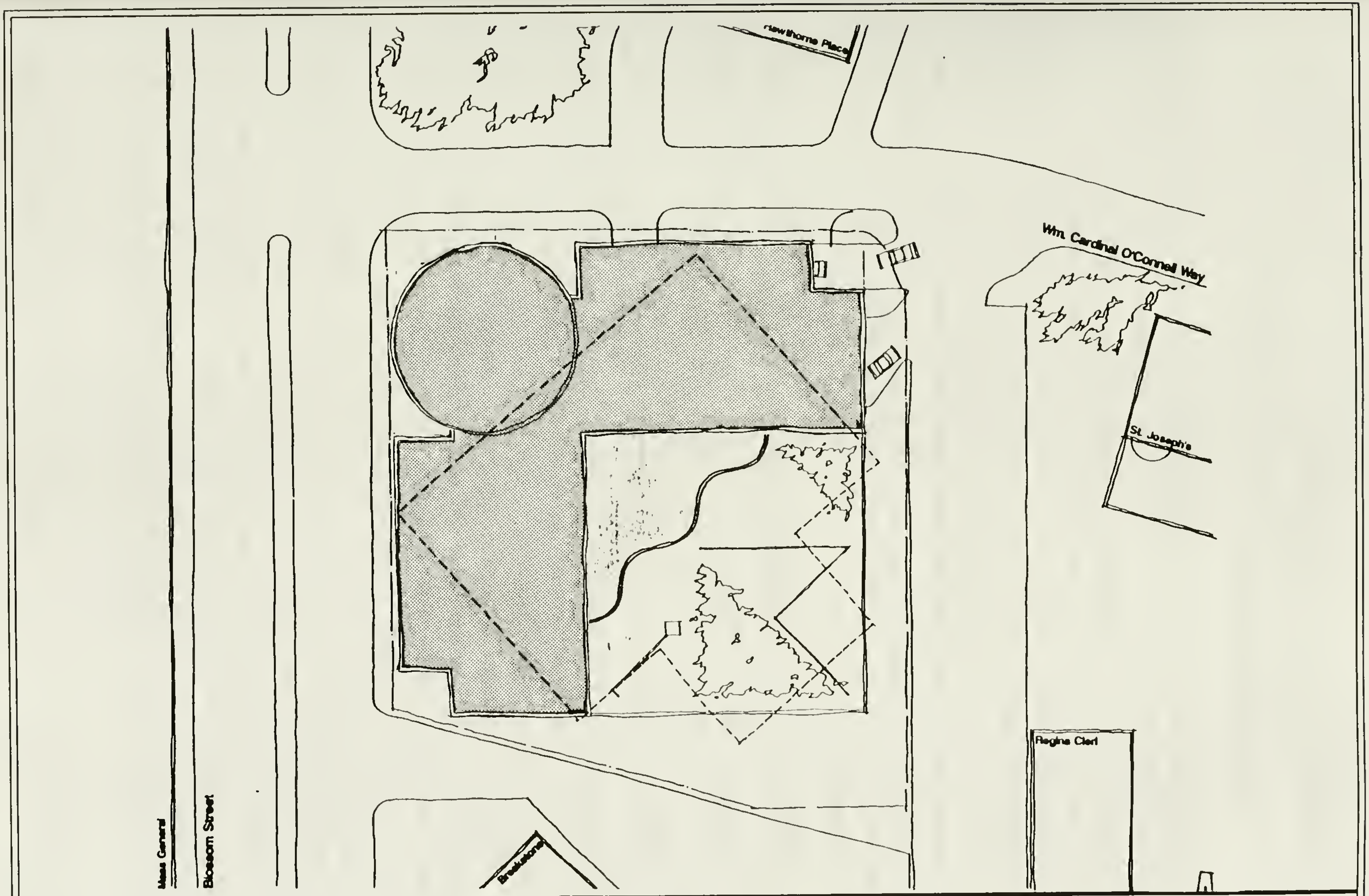


FIGURE III-2.5
PNF SITE PLAN, MARCH 1991
SHRINERS REPLACEMENT FACILITY

3.0 UPDATED PROJECT DESCRIPTION

3.1 Proposed Building Program

The optimum programmatic requirements of the prototype Burns Facility call for approximately 230,000 sf (as evidenced in the new Galveston and Cincinnati units). Due to site restrictions and the desire by the SHCC to work within the context of the neighborhood, a reduction in program to 200,000 sf was proposed by the SHCC.

The existing facility, designed and constructed in the late 1960s, has long been inadequate for the facility's needs. All areas of the hospital have expanded in scope, and overcrowded conditions have resulted in the temporary relocation of approximately 23,000 sf of research space to Cambridge (Kendall Square) and relocation of 3,600 sf of space to 90 Canal Street (medical records, business office, personnel quality improvement/risk management office). The redesign of the project in the DEIR/DPIR will require these off-site temporary locations until the completion of both Phase I and Phase II.

Increased research space is a small portion of the total new building increase. (Existing research space is approximately 16,500 sf, the proposed research space is 30,000 sf.) The research by the Shriners has produced many significant advances in burns treatment over the years, including the development of artificial skin and such medical programs as a "skin bank". These were wholly unforeseen 25 years ago.

Advances in treatment of burns victims has resulted in shorter inpatient stays, with increased outpatient care for many years to follow. This shift has resulted in the need for improved and expanded outpatient care areas, but at the same time, has not resulted in the need to increase the number of beds.

Acute Care and Reconstruction are the primary inpatient functions at the Institute. Outpatient Care will be expanded as will other support functions which are currently cramped in the existing building (see Table III-3.1 for Program Area Summary By Floor).

The currently proposed project is a nine-story structure with 2½ levels of below-grade parking. The Shriners have been negotiating for 100 spaces on-site. Four levels occur above the truss level and four below the truss level. Mechanical equipment is housed at the truss level (See Figures III-3.1 through III-3.3.)

As stated in the DEIR/DPIR, building on the existing site will be accomplished in two phases. Figure III-3.4 shows the Phase I and Phase II construction process. Phase I involves construction of a series of steel trusses over the existing building, which will support four levels above. Normal operations will be maintained in the existing facility

TABLE III-3.1
PROGRAM AREA SUMMARY BY FLOOR
SHRINERS REPLACEMENT FACILITY

LEVEL	FUNCTIONS	AREA (SF)
1	Lobby Auditorium, Receiving, Maintenance, Laundry	20,275
2	Research	24,533
3	Skin Bank, Clinical Lab, Personnel, Business Office, Materials Management, Housekeeping, Classrooms, Volunteers, Parent Facilities	22,517
4	Employee Lounge, Shriners Lounge, Employee Facilities, Administration, Research	22,517
5	Mechanical	22,173
6	Medical Records, Family Services, Graphic Arts, Physical Therapy, Outpatient Clinic	22,583
7	Pharmacy, Central Sterile, Central Activity, Reconstruction Beds, Parent Waiting	21,923
8	ICU Beds, Surgery, Resident On Call, Parent Waiting	21,683
9	Kitchen, Dining, Boardroom, Library, Administration	20,423
Roof	Penthouse	1,091
	TOTAL (MEDICAL)	199,718 sf
	PARKING	
1	Motor Lobby	4,292
P1 (Minus 1)	Parking	29,308
P2 (Minus 2)	Parking	24,312
PS (Minus 3)	Parking	11,500
	TOTAL (BELOW-GRADE PARKING)	69,412 sf

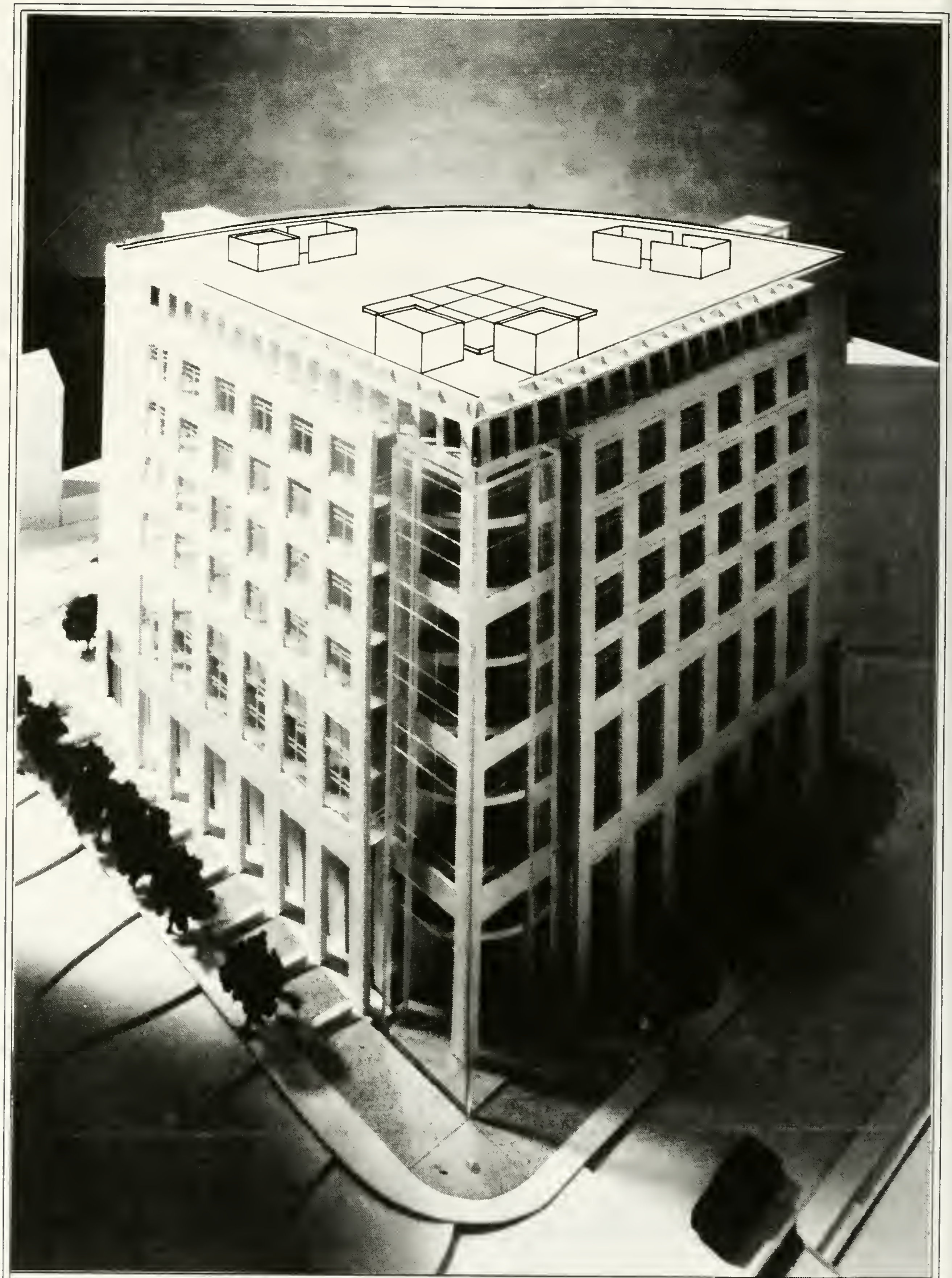


FIGURE III-3.1
VIEW OF MODEL OF THE SHRINERS REPLACEMENT FACILITY
AT BLOSSOM STREET AND WILLIAM CARDINAL O'CONNELL WAY

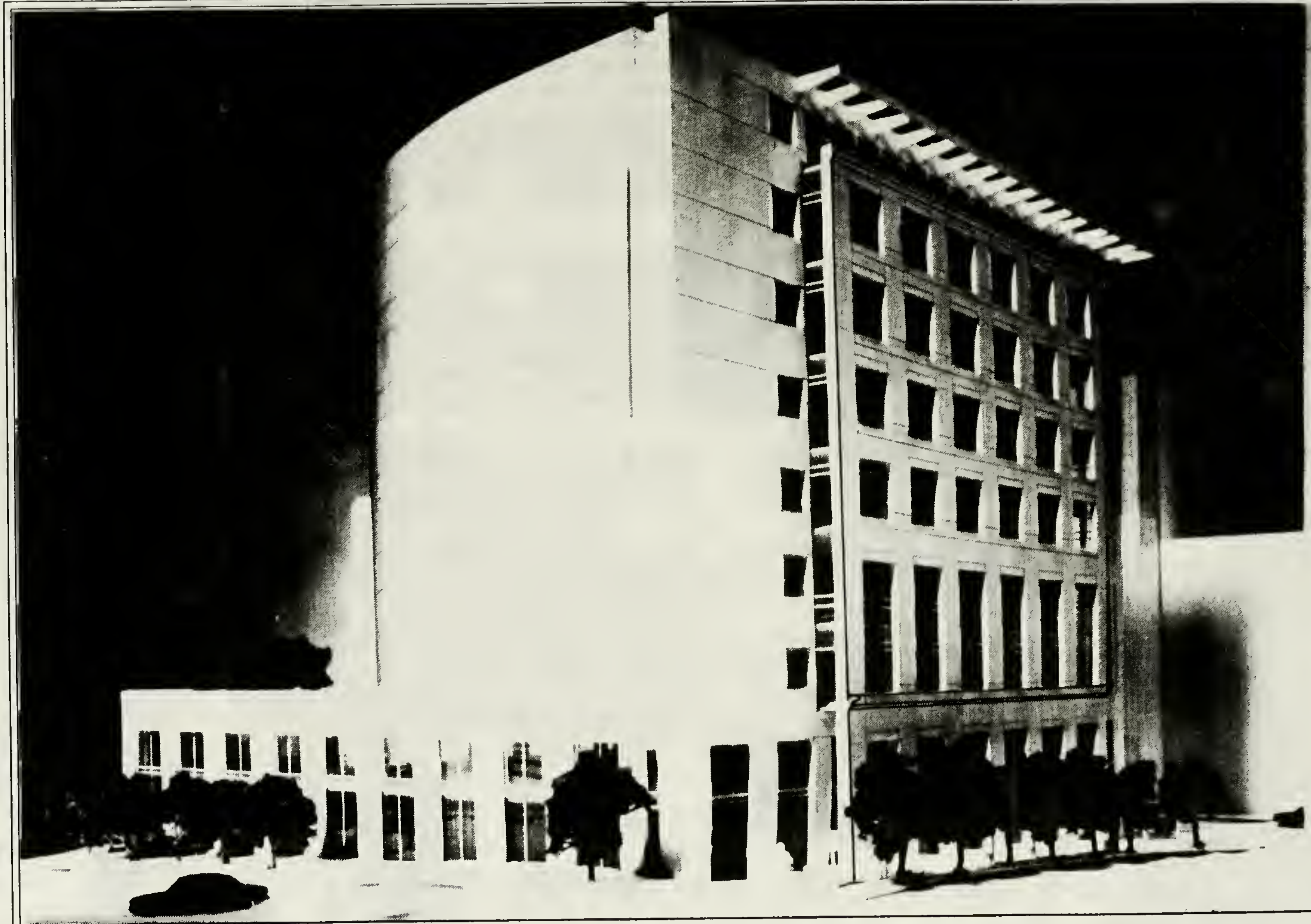


FIGURE III-3.2
VIEW OF MODEL OF THE SHRINERS REPLACEMENT FACILITY
ALONG WILLIAM CARDINAL O'CONNELL WAY

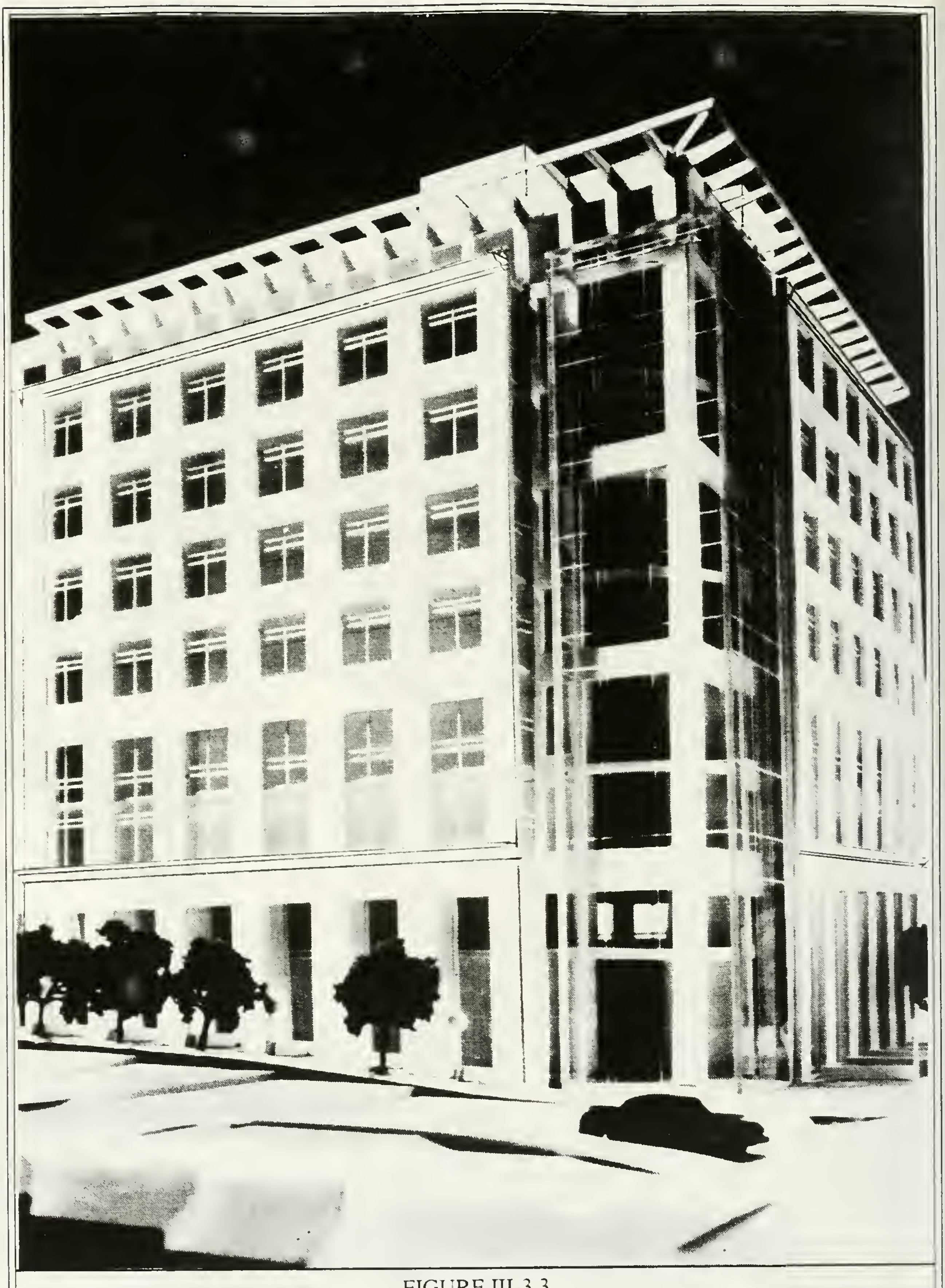
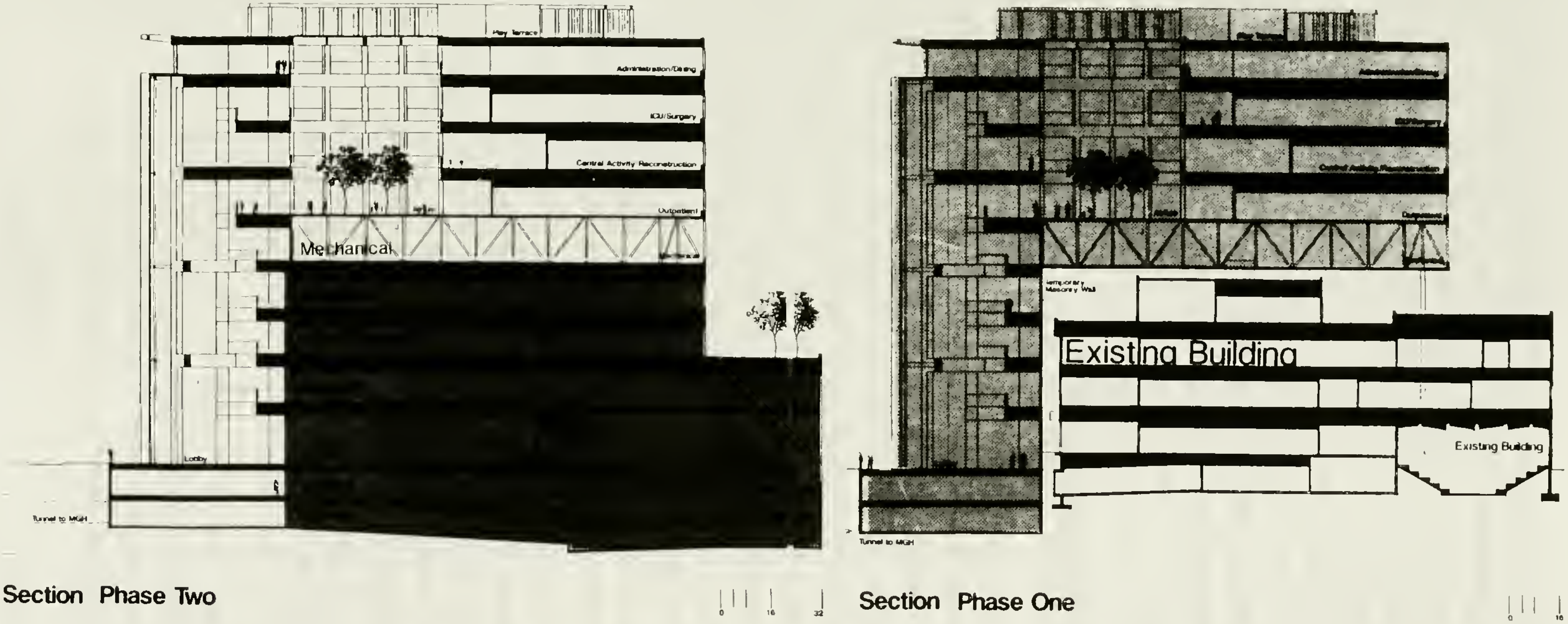


FIGURE III-3.3
VIEW OF MODEL OF THE SHRINERS REPLACEMENT FACILITY
AT GROUND LEVEL FROM TWO HAWTHORNE PLACE



Section Phase Two

Section Phase One

FIGURE III-3.4
CONSTRUCTION PHASES I AND II

while construction above is underway. Upon completion of Phase I, patients and staff will move into the upper levels. Phase II will then begin, which includes demolition of the existing facility and construction of four levels of hospital functions, and two and a half levels of below-grade parking. Patient care will not be uninterrupted during the construction period.

The area relocated to the position below the truss will not be available until completion of Phase II. Therefore, the research space which will be moved off-site during construction of Phase I will not return to the site until completion of Phase II. Also, other administrative functions will be relocated temporarily off-site prior to demolition of the existing building.

3.2 Revisions to Project Design

Since submission of the PNF, Shriners has considerably redesigned the facility in response to comments from the BRA, MEPA, the City of Boston Zoning Commission, the Hawthorne Condominium Trustees and others, which has resulted in a sizeable reduction in the floor plate such that all of the facades will comply with front yard setbacks as required by zoning. The height of the building has been lowered. The parking entrance has been moved from William Cardinal O'Connell Way to Blossom Street. The planting and vegetation plan has been revised. Shriners is committed to spend several millions of dollars to place all parking below ground. The FAR of the Replacement Facility will be approximately 4.5, admittedly above the 3.0 FAR allowed as of right, but considerably below the FAR of 8.0 set out in the Interim Planning Overlay District, Subdistrict M. There is, of course, no height limit in the H-3 District, but the new design, at 137 feet above-grade, will be substantially lower than the 155-foot height set out in the West End Urban Renewal Plan for this and other nearby parcels.

The project architects were also asked to consider the change in shadow effects if it were possible to eliminate one floor. Although the basic assumption of this exercise requested by a neighborhood group - that there should be reduction in the overall square footage of the medical clinical program - is not acceptable. Shriners needs the full 200,000 square feet. Also, the changes in shadow effects were insignificant (see figures in Section V-2.0).

The current design is very compatible to abutting properties. The south and east sides of the project are curved above the second floor, to allow views from the Blackstone and Regina Cleri buildings, and to avoid blocking views and sunlight from St. Joseph's Church. The building height is 137 feet, which is roughly 20 feet lower than the Two

Hawthorne Place building, and in keeping with the height of the Wellman Building, located at MGH across Blossom Street. The height allows greater views from adjacent buildings. The roof of the facility was planned as a play terrace to include planting, trellises, etc., allowing an attractive roofscape as viewed from Hawthorne Place and Longfellow Place. (This roof-garden was eliminated by the BRA Board vote of April 9, 1992 in response to complaints from Hawthorne Place residents about loss of views. See Section I-4.3).

Every effort has been and will continue to be made throughout the BRA design review and neighborhood processes to reduce any identified massing impacts on neighboring properties. In addition, the Blackstone property line will be more heavily planted and the existing open dumpster will be relocated to one of the three completely enclosed loading docks off the rear access road. The design of the facades and a parapet extension at the third floor will further break up the massing along Blossom Street and William Cardinal O'Connell Way.

It is also noted that the current 137-foot height to the top of the highest occupiable floor is a reduction by 18 feet over the height of the original design contained in the PNF.

The building height has been established by the positioning of the truss above the existing Shriners facility. Minimum clearance for construction exists between the top of the old building and the underside of the truss in an effort to keep the overall building height as low as possible. (In an effort to do this, the elevators in the existing building are receiving modifications to eliminate an existing penthouse on the roof, thereby eliminating elevator service into the existing mechanical penthouse. This saves approximately 8 feet in height, which would be required if the truss had to clear the penthouse.) The height, therefore, is not related to the ground floor functions or to the existence or non-existence of below-grade parking.

The trusses support four levels of new hospital space (Phase I) totalling 87,703 SF. The functions housed in these four levels are the minimum facilities needed allow Shriners to be a functional burn facility. Certain functions, including the skin bank, clinical laboratory, medical research, personnel and business offices will be required to be located off-site until completion of Phase II. While these are integral components of the facility, there is not adequate floor area in the Phase I area to accommodate them. Parent facilities, classrooms, and the main storage facilities will also not be within the project until Phase II completion.

3.3 Building Design Features

As described earlier, the building height and shape has been designed to respond to concerns of neighboring property owners. The design of the exterior is based on these factors as well as the restrictions inherent in construction around and over an existing building.

The mass of the building is expressed as masonry block which is carved and shaped to respond to specific site factors. The building walls re-establish a relationship with the adjacent streets, and the curved facade maintains views from and sunlight to neighboring parcel. On the west and north street, trees repeat a pattern established by the Wellman Building and provide an enhancement for the open area north of the site. A curved segment of the block is carved away at the southeast to form the curved wall. On the north and west, an arcade at grade level is cut out to visually increase the distance to the street as well as provide a protected entrance area. At the parapet, the ninth floor is cut back to form a terrace and to visually lessen the height of the street wall. The corners at the stairs are also set back from the main facade to further reduce the bulk of the main facade.

The curved building wall is carved from the masonry block. An aluminum and glass window wall is designed to appear lighter and less heavy than the masonry facades. The street walls are masonry, in response to the neighboring buildings. A base is designed to tie these differing facades together, and extend around four sides serving as a screen for the parking and service entrances on the south and east.

The masonry walls are designed in a way to articulate the various openings. A rusticated granite base extends for two levels, capped by a projecting cornice which visually reduces the height from the pedestrian level, followed by two-story openings containing levels 3 and 4. The fifth floor openings contain louvers, and are designed to fit within a grillework consistent with other openings. Levels 6 through 8 are a repetitive pattern of punched openings. The ninth level windows are stepped back and a trellis/cornice forms a parapet to complete the composition.

Materials on the perimeter will be of a pallette consistent with the neighborhood. A granite base at grade level will support a brick and pre-cast concrete facade. Pre-cast sills, lintels and other trim pieces will be integrated into the masonry walls. The lobby at the corner of the building will be largely a glass skin, allowing views into the facility. Other windows will be tinted and/or clear glass, with the exception of the curved wall. This wall will be a curtain wall made of aluminum members with a pattern of clear and/or tinted glass.

The building design was extensively reviewed and unanimously approved by the Boston Civic Design Commission.

3.4 Pedestrian Environment

The site area at the south side of the facility will be heavily landscaped. The sidewalk areas on William Cardinal O'Connell Way and Blossom Street will have planting areas with trees and broad steps leading into the building as previously noted, and discussed in greater detail in the next section. Lighting will be included at-grade level. Paving textures are a pattern of concrete and brick.

The impact of proposed design changes at the intersection of Blossom Street and William Cardinal O'Connell Way are illustrated in Figures III-3.5 and III-3.6.

Figure III-3.5 illustrates the existing sidewalk conditions as viewed from Blossom Street. There are several obstructions to a clear view of the intersection of Blossom Street and William Cardinal O'Connell Way. This sketch, taken from a photograph, illustrates that the existing retaining wall of the raised planter (in front of the existing facility) blocks the view of the intersection. This retaining wall varies in height from 4.5 feet to 8.0 feet above the sidewalk. The on-street parking also blocks the view.

Figure III-3.6 illustrates the proposed new sidewalk design. Although the building is located closer to the street, the view of the intersection is less obstructed. This is largely due to the removal of the planter. The sidewalk level extends from the curb to the face of the building. The glass corner affords additional visibility of the intersection. (As a result of further discussions with the neighborhood, this glass corner will be setback an additional five feet from the William Cardinal O'Connell Way and Blossom Street intersection.) The view of the Hawthorne entrance drive is also visible. The on-street parking, as in the existing condition, partially blocks the view.

There are several pedestrian circulation paths in the area of the Shriners Burns Institute (see Figure III-3.7). Both sides of Blossom Street carry pedestrians between Charles River Park to the north and shopping and the transit stop to the south on Cambridge Street. Pedestrian traffic along William Cardinal O'Connell Way is also present. Pedestrians moving from residential towers (to the northeast) to MGH use this pathway. Pedestrians also move between William Cardinal O'Connell Way through the garden between St. Josephs' Church and Regina Cleri, proceeding to destinations east and west of the Shriners Burns Institute.

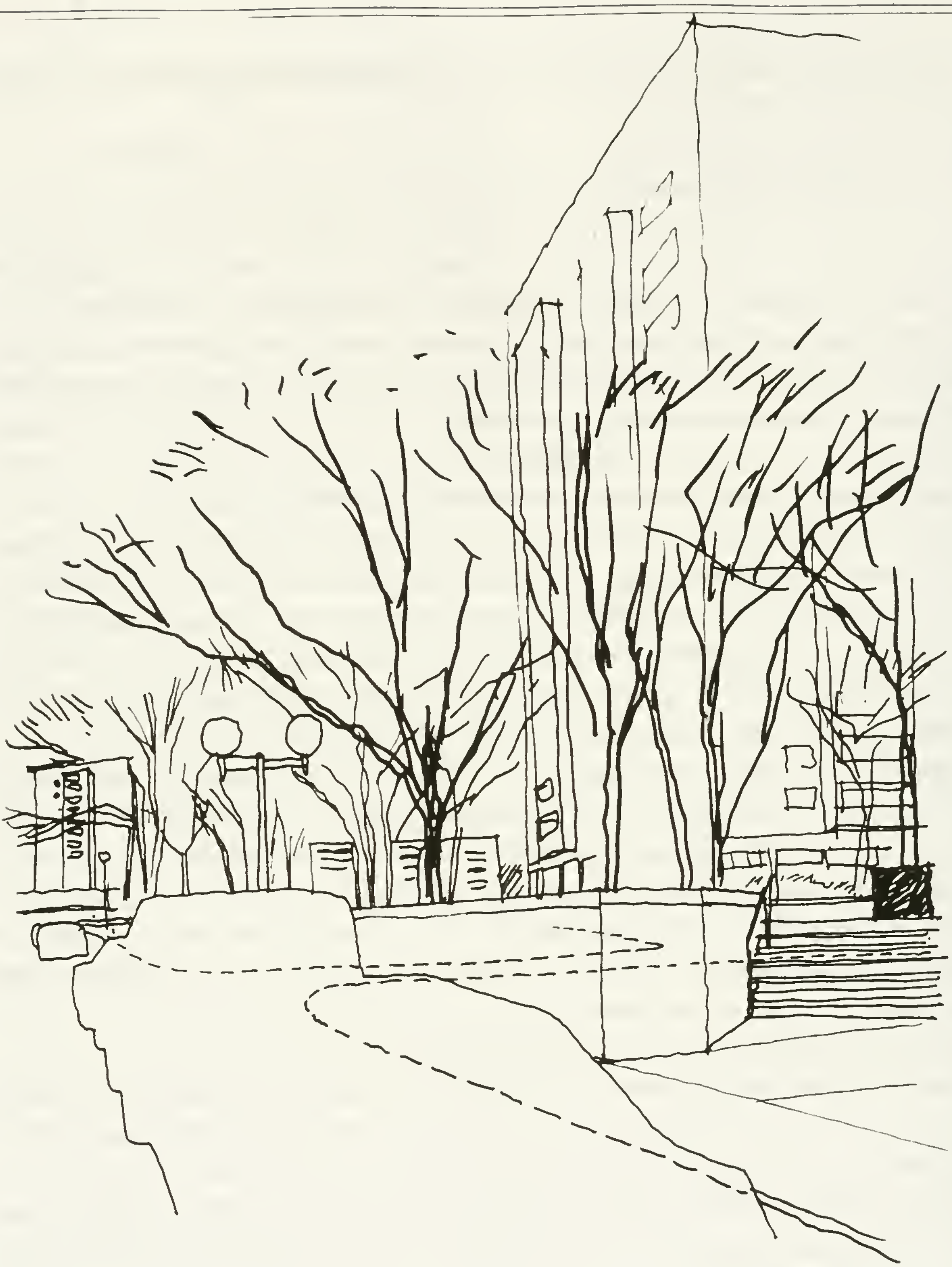


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FIGURE III-3.5
EXISTING SIDEWALK AT BLOSSOM STREET
AND WILLIAM CARDINAL O'CONNELL WAY

hmm

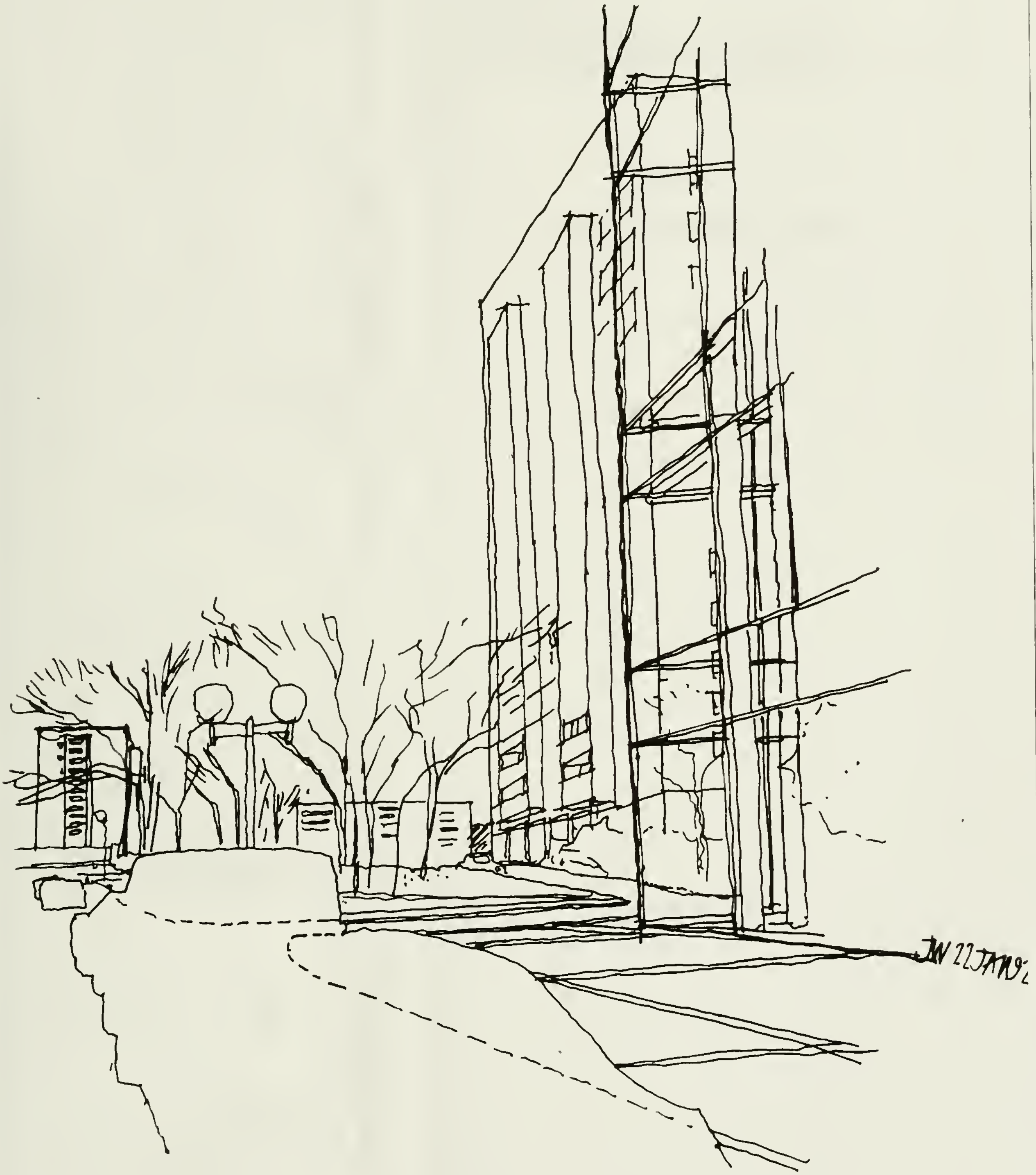
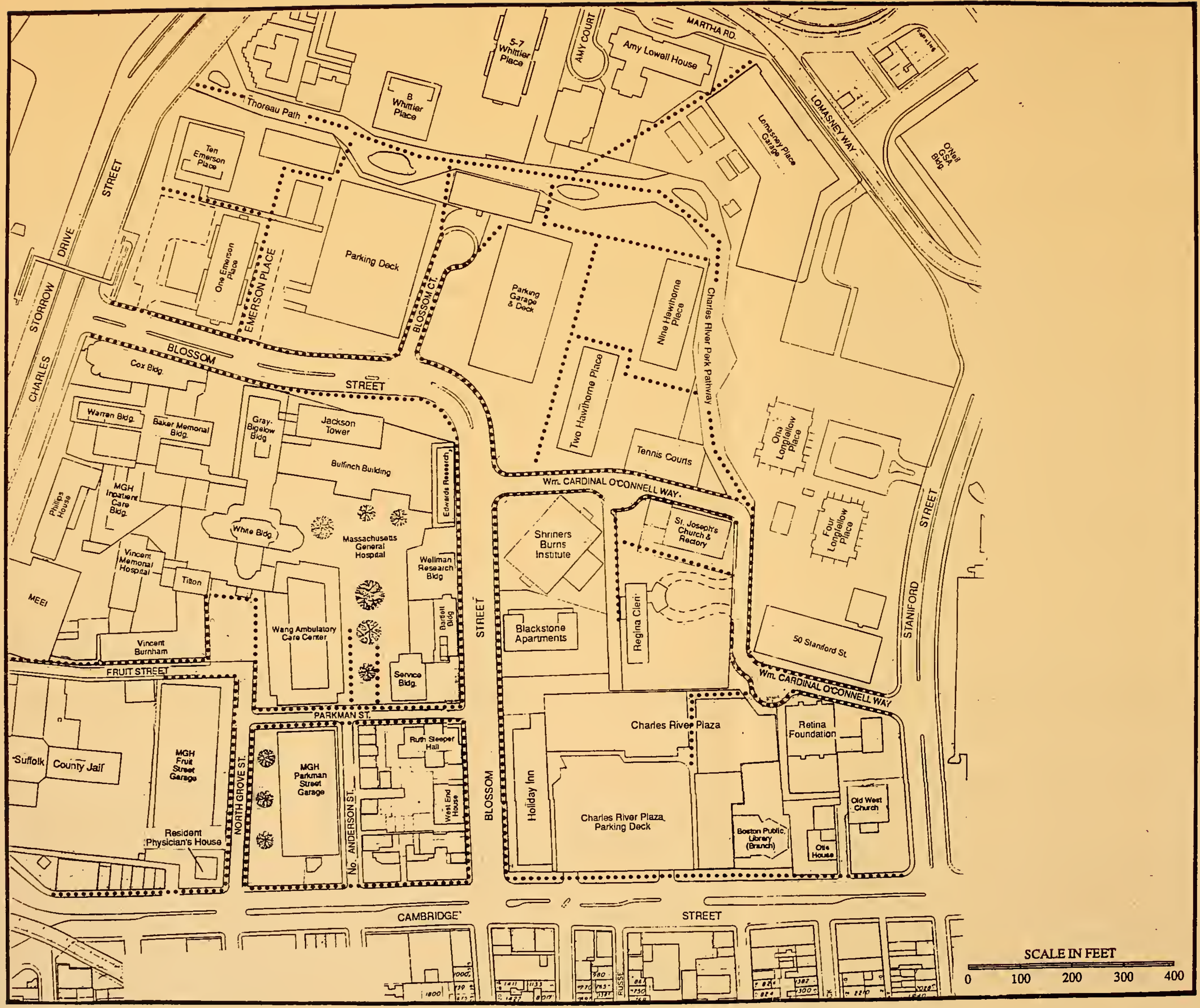


FIGURE III-3.6
PROPOSED SIDEWALK AT BLOSSOM STREET
AND WILLIAM CARDINAL O'CONNELL WAY

FIGURE III-3.7
AREA-WIDE PEDESTRIAN MOVEMENT



LEGEND

•••••• Existing Major Pedestrian Routes.

The proposed streetscape treatment of the Shriners Burns Institute will improve and enhance these areas of pedestrian movement. The current 8-foot sidewalk will be replaced by a broader sidewalk, protected from the street by a landscaped buffer (see Figures III-3.8 and III-3.9). Trees in the buffer will provide an attractive green zone between pedestrians and vehicles. A recessed pedestrian arcade will further increase the width of the pedestrian areas. A rich pallette of materials, including granite and brick, will make a pleasing visual experience for pedestrians. Lighting will add to the character of the street. The lighting at the sidewalk, combined with lighting from the lobby areas of the building (along Blossom Street and William Cardinal O'Connell Way) will improve visibility at night, resulting in a safer environment for pedestrians.

Shriners is also committed to review pedestrian movement across William Cardinal O'Connell Way and Blossom Street and assist in the implementation of improved pedestrian crossing points, if warranted (these are discussed in detail in Section IV-4.2.2).

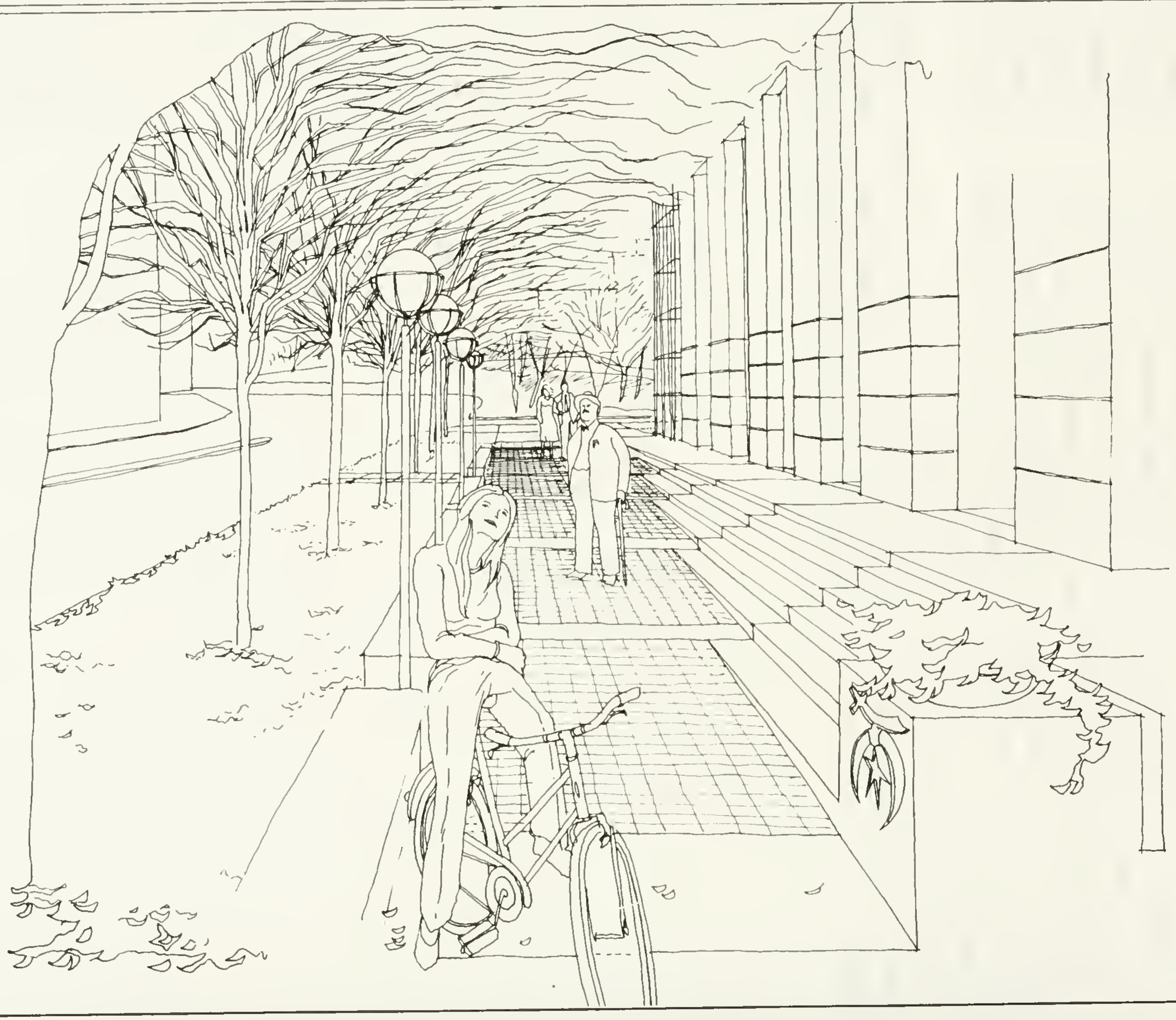


FIGURE III-3.8
STREETSCAPE TREATMENT ALONG BLOSSOM STREET

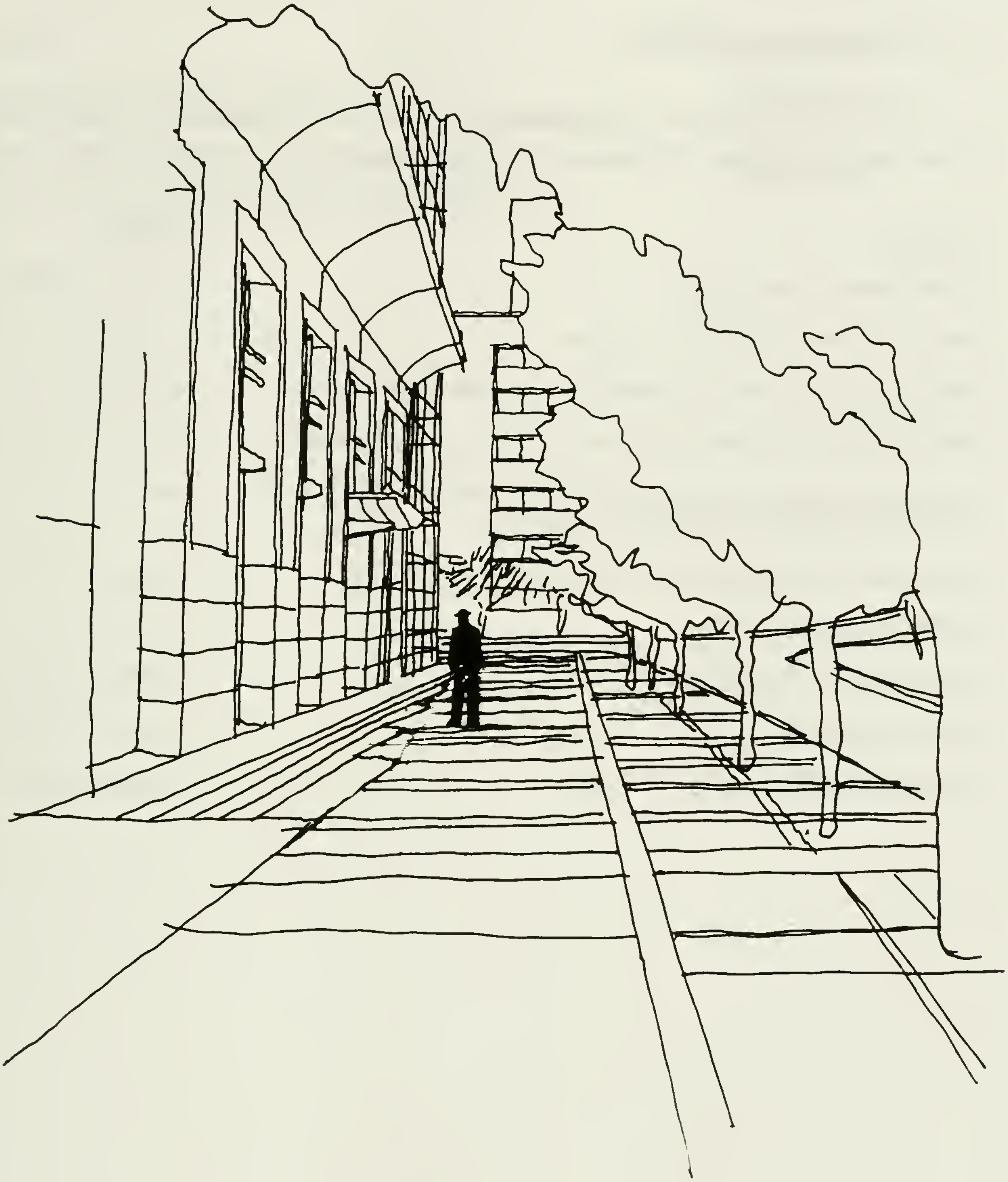


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FIGURE III-3.9
STREETSCAPE TREATMENT AT
WILLIAM CARDINAL O'CONNELL WAY

FEIR Submittal to MEPA	February
MEPA issuance of FEIR Certificate	April 3, 19
BRA Board Approval of Development Impact Project Plan	April 9, 19
BRA Issuance of DPIR Preliminary Adequacy Determination	April 23, 1
Zoning Commission approval of Map Amendment No. 281 for "U" designation for Burns Institute Site	June 12, 1
Board of Appeal Hearing on Requested Exceptions	August 4,
FPIR Submittal to BRA	August, 19
Design Development Phase Approval	Septembe
Site Preparation	Septembe
Construction Documents Completion	December

Activity	Schedule
Construction Completion - Phase 1 (Phase 1 - Replacement Hospital above Existing Building)	October, 1994
Construction Completion - Phase 2 (Phase 2 - Demolition of Existing Hospital and Infill of New Hospital Construction)	March, 1996

IV. Transportation Component

IV. TRANSPORTATION COMPONENT

1.0 INTRODUCTION AND UPDATED STATUS

1.1 Study Area

In accordance with the scope issued by the Boston Redevelopment Authority (BRA), the Transportation Component will evaluate the traffic and parking impacts resulting from the expansion of the Shriners Burns Institute. Utilizing standard traffic engineering principles, the analysis will:

- Define existing traffic, parking and transit conditions in the area;
- Evaluate the project's short-term traffic impacts related to construction activity;
- Evaluate long-term impacts on traffic and parking;
- Consider loading and service vehicles;
- Identify appropriate measures to mitigate project impacts; and
- Prepare a monitoring program of long-term travel behavior.

The study area defined by the Boston Transportation Department (BTD) and the MEPA Unit of the Executive Office of Environmental Affairs for this project is shown in Figure IV-1.1. The study area is roughly bounded by Blossom Street, William Cardinal O'Connell Way, Staniford Street and Cambridge Street.

1.2 Study Methodology

The Transportation Impact Analysis was conducted in three distinct phases. The first phase involved an inventory of existing conditions and travel demand characteristics in the area. The inventory included researching information on all existing activities within the area; conducting vehicular turning movement counts during the peak commuter travel periods (7:00 to 9:00 AM and 4:00 to 6:00 PM) at four critical intersections within the immediate study area (Figure IV-1.1); collecting vehicular and pedestrian traffic accident data; and conducting an analysis of existing operating conditions. Although the project is a medical facility with a work shift beginning at 7:00 AM and ending at 3:00 PM, the peak commuter travel periods were selected to insure a conservative analysis since background traffic volumes are at their highest during these four hours.

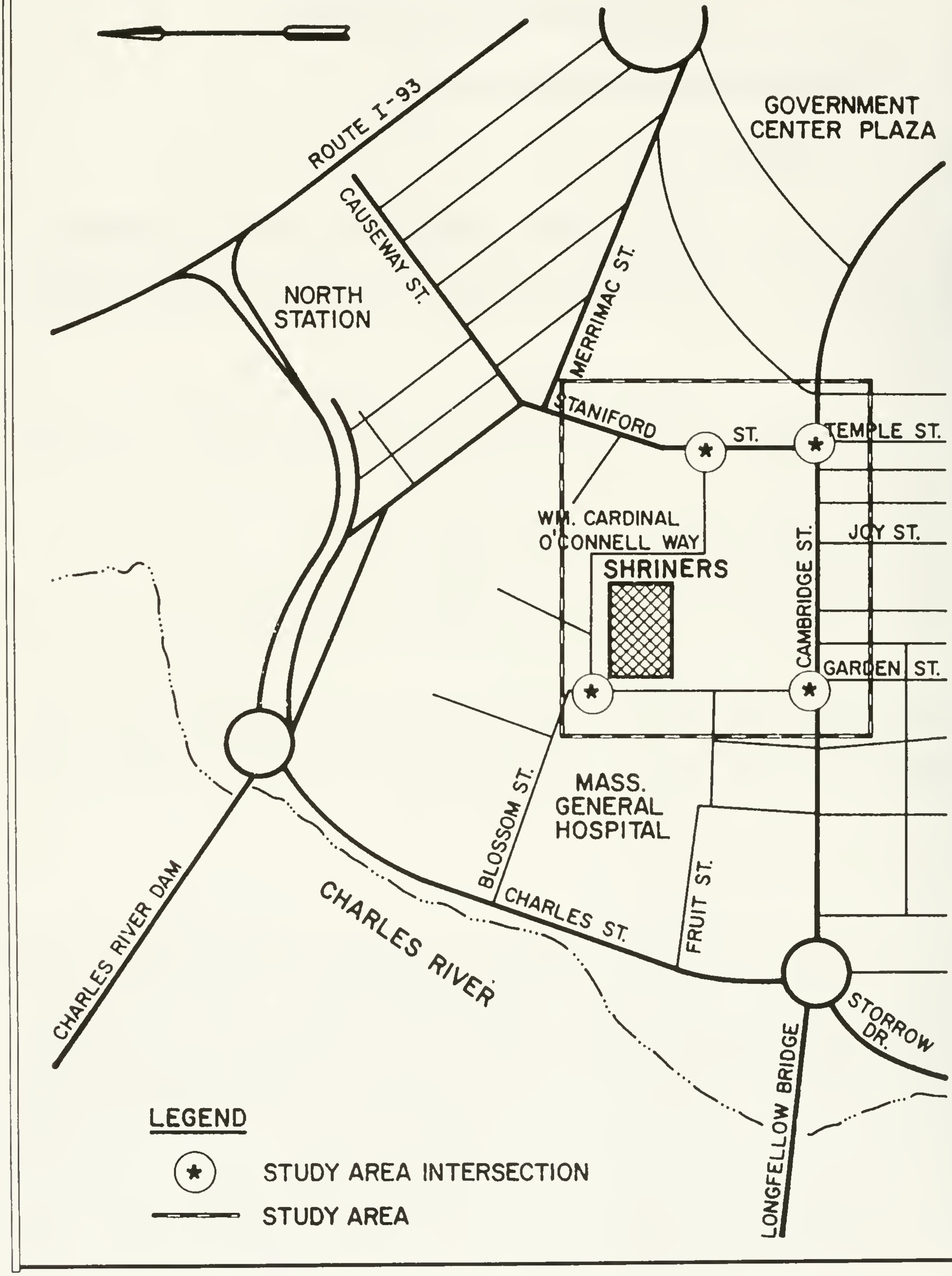

FIGURE IV-1.1
STUDY AREA

The second phase (the No-Build) involved an analysis of trip generation and distribution paths of other proposed projects in the area, as well as the Shriners Burns Institute project. Specific travel demand forecasts for the projects were assessed in the second phase.

The third and final phase (Build) included evaluation of the impacts of the project on the transportation system, identification of measures to mitigate impacts, and the development of a monitoring program.

1.3 Updated Status/Transportation Impact Analysis

Shriners and its transportation consultant have continued discussions on both traffic and parking issues with the BRA, BTD, MEPA office, and neighborhood representatives since the filing of the DEIR/DPIR and Final Environmental Impact Report (FEIR). Major changes that have resulted from these discussions are identified below:

- The DEIR/DPIR proposed a total parking supply of 249 spaces, 150 on-site, while the FEIR reduced those numbers to 225 and 133, respectively. As a result of further public discussions, Shriners has been negotiating to further reduce total on-site parking spaces to 100 spaces.

- Shriners has met with the BRA and BTD on construction period impacts on Blossom Street.

- Shriners has further analyzed the travel patterns of people using the existing 196-seat auditorium. The results of the survey have been incorporated into the analysis.

2.0 EXISTING CONDITIONS

2.1 Traffic

The roadways within and adjacent to the study area consist of both local and arterial streets. Roadway characteristics and traffic volumes were compiled to analyze existing conditions.

2.1.1 Roadway Network Characteristics

The site of the Shriners Burns Institute is bounded by William Cardinal O'Connell Way to the north, St. Joseph's Church and the Regina Cleri House for Retired Clergy to the east, Blossom Street to the west, and the Blackstone elderly housing development to the south. Land use in the area is predominantly medical and residential with the Charles River Park development just north of William Cardinal O'Connell Way.

The area street network consists of Blossom Street, William Cardinal O'Connell Way, Staniford Street and Cambridge Street. Regional access to the study area is provided by Storrow Drive from the west, and Interstate Route 93 (Central Artery and Southeast Expressway) from the north and south. Local access to and from the site is provided by the Longfellow Bridge, Storrow Drive, Cambridge Street and Staniford Street.

Cambridge Street is a four-lane, two-way arterial near the study area, running in an east-west direction. The roadway provides access between the downtown area of Boston and the City of Cambridge via the Longfellow Bridge. In general, two lanes of travel are provided in each direction with additional lanes for left-turns at certain locations. Metered parking is allowed along the northern side (outbound) of the roadway, while parking is restricted to loading activities along the southern side during the weekdays. In addition, standing is prohibited during the morning peak period (7:00 to 9:30 AM) on the inbound side and on both sides during the afternoon peak period (4:00 to 6:00 PM). This provides a third travel lane, although drop-offs, pick-ups and illegally parked vehicles often restrict travel in this lane. A raised concrete median separates the traffic flow within the study area, with median breaks at intersections.

Within the study area, Cambridge Street has four signalized intersections:

- Blossom Street/Garden Street
- Staniford Street/Temple Street

- Joy Street
- Boston Fire Department Station/Parking Lot

Blossom Street is a wide, two-way roadway which runs from Cambridge Street north and west to Charles Street. The roadway provides two travel lanes in each direction with a raised concrete median dividing the opposing flows, with breaks at intersections. Metered parking is allowed along both sides, except where restricted for loading activities.

William Cardinal O'Connell Way is a two-lane roadway, providing approximately 12 feet of pavement width in each direction. There are no pavement markings along the roadway and parking is not allowed on either side. The roadway runs from Blossom Street easterly to Staniford Street, with two 90° turns along the roadway. Both ends of William Cardinal O'Connell Way are unsignalized intersections, with median breaks provided at both Blossom Street and Staniford Street to allow full movements into and out of William Cardinal O'Connell Way. In addition, the garage entrance to the Division of Employment Security is located on Staniford Street diagonally across from William Cardinal O'Connell Way, and vehicles are allowed to reverse direction along Staniford Street at the median break.

Staniford Street also provides two-way travel with two lanes in each direction, separated by a raised brick island. The roadway runs from Cambridge Street northerly to the Merrimac Street/Causeway Street intersection. Metered parking is provided on both sides.

The intersection of Blossom Street with Cambridge and Garden Streets is a signalized 4-way intersection. Cambridge Street provides two travel lanes in each direction, with a third travel lane on one or both sides during peak periods when parking is prohibited. In addition, the Cambridge Street inbound approach provides a left-turn lane for vehicles turning onto Blossom Street. This movement is controlled by a separate protected left-turn phase. Blossom Street provides a two-lane approach to the intersection while Garden Street provides one-way travel toward the intersection. The traffic signal at Blossom and Garden Streets is a fully-actuated system, with wire-loop detection on all approaches. The fully-actuated system allows proportional green time based on the volumes on the various approaches.

Cambridge Street intersects Staniford Street/Temple Street to form a signalized 4-way intersection. The geometry and signal phasing is similar to the Cambridge Street/Blossom Street intersection. Staniford Street provides a two-lane approach to the intersection, while Temple Street is a one-way street toward the intersection.

2.1.2 Existing Traffic Volumes

The analysis of existing traffic conditions is based on vehicular volumes collected during the morning and afternoon peak commuter travel periods on typical weekdays in May and June, 1991 at the following locations:

- Blossom Street/William Cardinal O'Connell Way
- William Cardinal O'Connell Way/Staniford Street
- Staniford Street/Cambridge Street
- Cambridge Street/Blossom Street

The data collected from the counts revealed that the peak one-hour flows generally occur between 8:00 to 9:00 AM and 4:30 to 5:30 PM for the study area. Appendix A-1 contains copies of the actual field data. Due to nightly street cleaning operations, automatic traffic recorder counts were not obtainable.

In order to provide a reasonable data base to evaluate the operations of an intersection, a design hour volume is usually determined. The design hour volume is derived from data by the Massachusetts Department of Public Works (MDPW), which maintains a network of permanent traffic volume recording stations throughout the Commonwealth. According to data at the nearest MDPW traffic recording station, located on Route I-93 north of Southampton Street (Station #81), the month of August has the highest average volumes. These volumes are approximately 3% greater than the month of May, while the difference between June and August traffic volumes is negligible (see Table IV-2.1). Thus, the volumes collected in May for this analysis were adjusted by a factor of 1.03 to reflect peak seasonal traffic, while the June volumes remained unchanged. The volumes found in Figures IV-2.1 and IV-2.2 reflect these adjustments.

2.1.3 Existing Traffic Conditions

The methodology used to evaluate traffic conditions in this report is based on the standardized procedures outlined in the 1985 Highway Capacity Manual (HCM) published by the Transportation Research Board. According to this document, the ability of a roadway to handle a given volume of traffic is largely controlled by its intersections. Therefore, the TAP focuses on the analysis of intersection capacities within the study area.

TABLE IV-2.1
MONTHLY TRAFFIC VOLUME VARIATIONS

Month	Volume	Peak Factor
January	157,188	1.15
February	167,708	1.08
March	175,502	1.03
April	176,590	1.03
May	176,632	1.03
June	180,906	1.00
July	177,619	1.02
August	181,469	1.00
September	178,220	1.02
October	178,086	1.02
November	172,000	1.06
December	165,947	1.09

Source: Massachusetts Department of Public Works, Traffic Recording Station #81 located at Route I-93 north of Southampton Street.

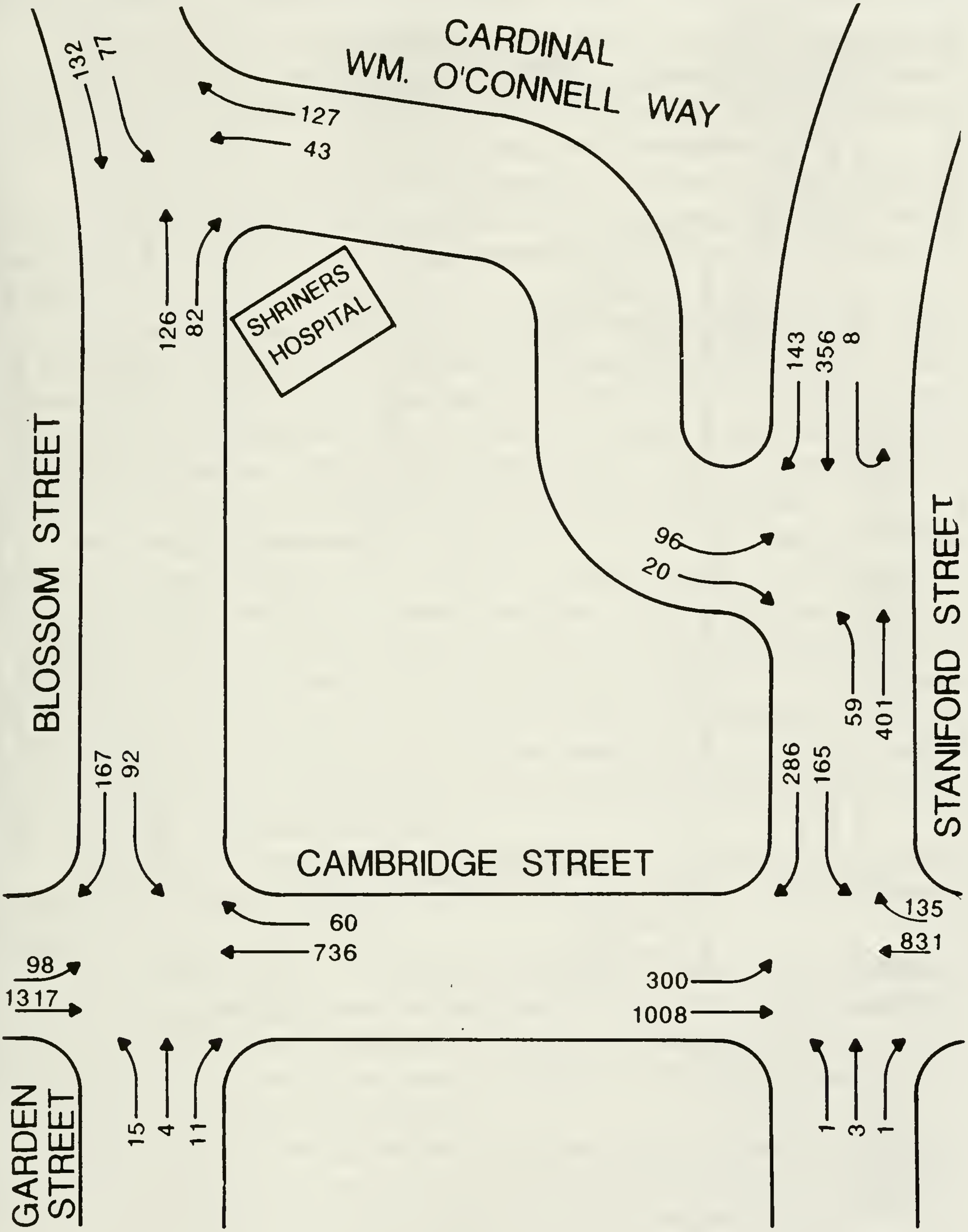

FIGURE IV-2.1
EXISTING AM PEAK HOUR TRAFFIC VOLUMES

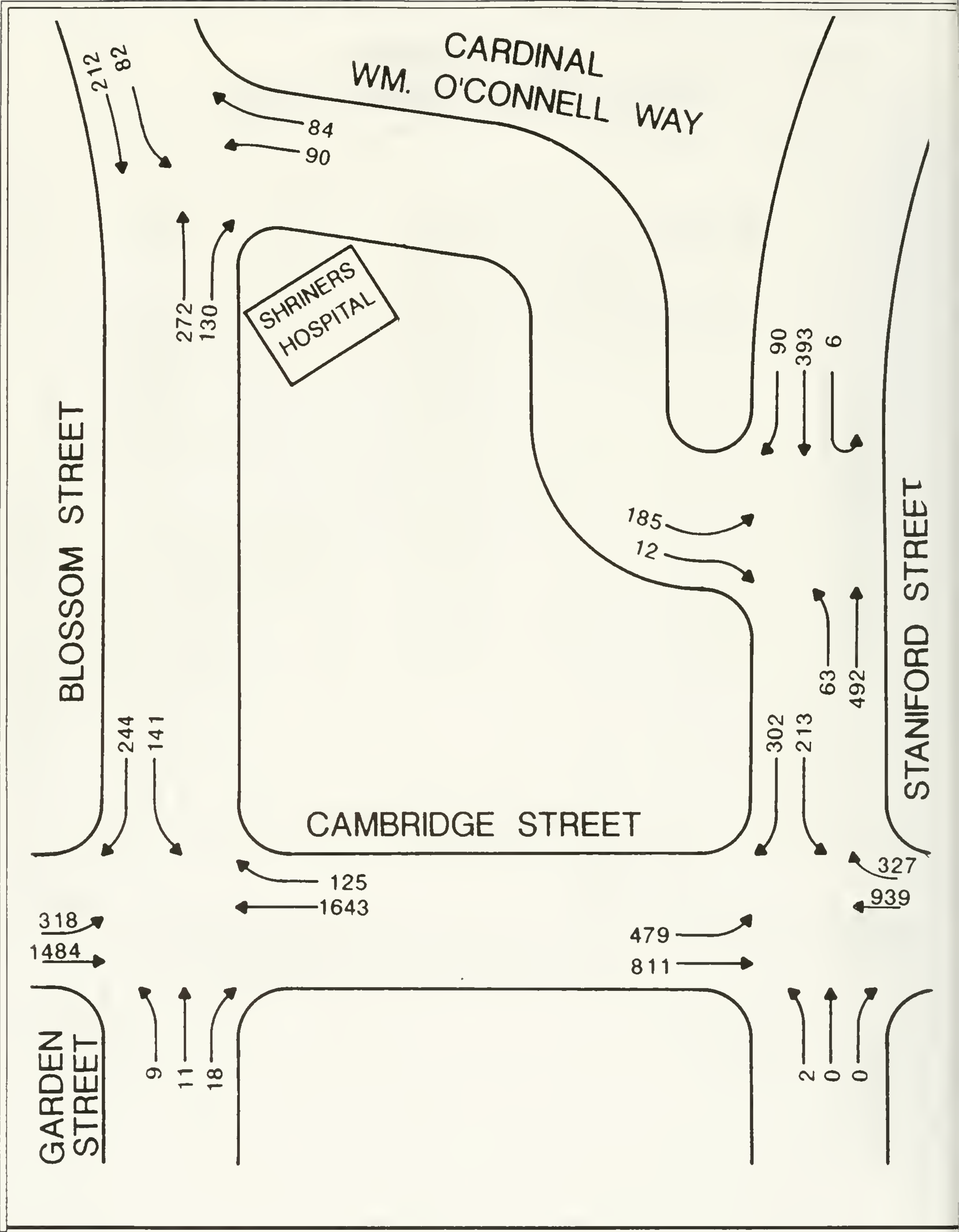

FIGURE IV-2.2
EXISTING PM PEAK HOUR TRAFFIC VOLUMES

The HCM defines six discrete levels of service (LOS). These levels were developed to describe actual traffic operating conditions ranging from free flow (LOS A) to extreme congestion (LOS F). The levels of service take into account the relationship between traffic volume, intersection geometry and operating speed and conditions.

The level of service for a signalized intersection is defined in terms of delay, a measure of driver discomfort, fuel consumption and lost travel time. Specifically, level of service criteria are stated in terms of the average stopped delay per vehicle as shown in Table IV-2.2.

The operational analysis methodology provided by (HCM) considers the full details of each of four components at a signalized intersection: demand (service flow rates), geometric design (characteristics), signal phasing and timing, and the level of service that results from these components. This operational methodology has been incorporated by the Central Transportation Planning Staff (CTPS) in their computer software program, "Capacity of Intersections" (CINCH - April, 1988), and is used in this analysis.

The unsignalized intersections within the study area were analyzed utilizing methodology also contained in the HCM. The capacity analysis of an unsignalized intersection differs from that of a signalized one, since conflicting traffic streams do not have the benefit of traffic signal devices to coordinate and facilitate movement. The methodology uses traffic survey data in determining the capacity of a minor street approach at an intersection where the minor street traffic flow is controlled by use of a STOP or YIELD sign. These movements include vehicles turning right from a minor street onto a major street, turning left from a minor street onto a major street and turning left from a major street onto a minor street.

The difference between the capacity and the actual or projected traffic volumes is defined as the reserve capacity. Table IV-2.3 demonstrates the relationship between reserve capacity and levels of service.

The analyses of the two signalized intersections indicate that the Blossom Street/Cambridge Street intersection currently operates under LOS B during the morning peak hour and LOS D during the afternoon peak hour. The Cambridge Street intersection with Staniford and Temple Streets operates at LOS B during the morning peak hour and declines to LOS E in the afternoon peak hour.

Movements to and from the unsignalized William Cardinal O'Connell Way/Blossom Street intersection currently operate under LOS A conditions during the morning peak hour. During the afternoon peak hour, vehicles turning onto Blossom Street from William Cardinal O'Connell Way face LOS C conditions, while the left-turn from Blossom Street onto William Cardinal O'Connell Way operates at LOS A.

TABLE IV-2.2
LEVEL OF SERVICE CRITERIA - SIGNALIZED INTERSECTIONS

Level of Service	Stopped Delay Per Vehicle (Seconds)
A	Up to 5.0
B	5.1 to 15.0
C	15.1 to 25.0
D	25.1 to 40.0
E	40.1 to 60.0
F	Over 60.0

TABLE IV-2.3

LEVEL OF SERVICE CRITERIA - UNSIGNALIZED INTERSECTIONS

Reserve Capacity	LOS	Expected Delay
400 or more	A	Little or no delays
300 to 399	B	Short traffic delays
200 to 299	C	Average traffic delays
100 to 199	D	Long traffic delays
0 to 99	E	Very long traffic delays
Less than 0	F	Extreme delays - queuing may cause congestion

The most significant delays at the unsignalized intersections occur to motorists exiting from William Cardinal O'Connell Way onto Staniford Street. This movement operates at a LOS E during the morning peak hour, and a LOS F during the afternoon peak hour. These levels of service are primarily the result of moderate traffic volumes on Staniford Street. However, left-turns from Staniford Street in either direction function at LOS A during both the morning and afternoon peak hours.

Table IV-2.4 displays the results of the analyses in terms of average vehicle delays, reserve capacities, and levels of service. Appendix B-2 provides the results of the capacity analyses.

When analyzing traffic conditions in urban areas such as Boston, the relationship of various factors to actual traffic conditions must be taken into consideration. Factors which can affect levels of service include double-parked vehicles, illegal pedestrian crossings and access/egress to loading zones. While the intersection methodologies can account for legal parking and pedestrian activities at intersections, the above indeterminate factors will have an impact on operations.

The capacity analyses conducted for the two signalized intersections did not take into consideration the additional lane(s) made available during the peak periods when parking is prohibited on Cambridge Street. The actual operations of the two intersections may be better than noted here. However, as a "worst-case" scenario, the intersections operate as shown in Table IV-2.4. Enforcement of the existing regulations can negate the effects of these factors, as discussed hereinafter, and results in dramatically improved conditions.

2.1.4 Accidents

Accident records were obtained from the Massachusetts Registry of Motor Vehicles (MRMV) for the three latest years of availability (1988 through 1990). During this three-year period, a total of 35 collisions were reported at the study area intersections, involving 71 vehicles, including six taxi-cabs. Eighty-six percent (86%) of the accidents occurred at the Cambridge Street intersections with Blossom Street (12) and Staniford Street (18). The remaining five collisions took place at the Blossom Street/William Cardinal O'Connell Way intersection. No accidents were reported at the Staniford Street/William Cardinal O'Connell Way intersection. Less than half of the collisions resulted in personal injuries, as only thirteen people reported any type of injury.

TABLE IV-2.4

EXISTING OPERATING CONDITIONS

UNSIGNALIZED INTERSECTIONS	AM PEAK HOUR R.C.	AM PEAK HOUR LOS	PM PEAK HOUR R.C.	PM PEAK HOUR LOS
Blossom Street/William Cardinal O'Connell Way				
- Left turns from Blossom Street SB	804	A	664	A
- All moves from William Cardinal O'Connell Way	576	A	254	C
Staniford Street/William Cardinal O'Connell Way				
- Left turns from Staniford Street NB	518	A	497	A
- Left turns from Staniford Street SB	634	A	564	A
- All moves from William Cardinal O'Connell Way	25	E	-117	F

SIGNALIZED INTERSECTIONS	AM DELAY	AM LOS	PM DELAY	PM LOS
Cambridge Street/Blossom Street	6.0	B	33.5	D
Cambridge Street/Staniford Street	13.0	B	55.2	E

Rear-end (10) and angle (15) type collisions were the most common types of accident, and are the most frequent types found at signalized intersections. Since most of the roadways are divided by some sort of median treatment, head-on collisions are virtually non-existent.

Eighty percent of the accidents, or 28 of the total, occurred under clear and dry conditions with only four accidents taking place under adverse weather conditions (rain, snow, etc.). Three of the accidents occurred during the morning peak two-hour period, with six accidents taking place between 4:00 PM and 6:00 PM.

Table IV-2.5 summarizes these accidents in further detail. It should be noted that mid-block accidents were not included in the analysis since their location is impossible to ascertain from the MRMV records.

2.2 Parking

The Shriners have been negotiating for the construction of 100 parking spaces to be located within an enclosed 2½ level, below-grade garage. This would be a reduction of 33 spaces from the number proposed in the DEIR/DPIR. The present lack of adequate parking spaces, particularly for out-patients and visitors, has created the immediate need for adequate and visible spaces within the area. Presently, out-patients and visitors park at metered spaces within the immediate area or at commercial garages. Parking is a significant expense to the out-patients and visitors particularly because of the frequency of the trips.

As part of the analysis, an exhaustive survey of the travel characteristics of employees, staff, patients, visitors, and auditorium users has been conducted. Results, which are presented in the following sections, will show the need for parking, particularly for out-patients and patient visitors who presently drive to the site and park at various locations within the study area.

2.2.1 Existing Parking Supply

Currently, 127 reserved parking spaces are available for employees, volunteers, and Board members of the Shriners Burns Institute. Only three of these spaces are located on site, at the rear of the Institute, leaving 124 off-site spaces in two private garages. There are 114 spaces located at the adjacent Hawthorne Place Garage, 104 of which the

TABLE IV-2.5
TRAFFIC ACCIDENT SUMMARY AT STUDY AREA INTERSECTIONS, 1988 - 1990

Total	35
Injuries	13
Vehicles	71

Type	
Rear-end	10
Angle	15
Other	10

Weather	
Clear	28
Rain	4
Other	3

Year

1988 - 13
1989 - 8
1990 - 14

Day	
Sunday	2
Monday	3
Tuesday	3
Wednesday	6
Thursday	6
Friday	9
Saturday	6

Time	
Mid. - 7 AM	2
7 AM - 9 AM	3
9 AM - 4 PM	15
4 PM - 6 PM	6
6 PM - Midnight	9

Institute owns, and 10 of which are under lease agreement. The remaining spaces are leased at the Charles River Garage on Lomasney Way. There is no parking available for outpatients or visitors.

In order to determine the utilization of existing commercial parking facilities in the study area, the BTD conducted a Parking Utilization survey in the Spring of 1991. The unpublished survey, which was based on one-time visits to 11 parking facilities located in the area bordered by Cambridge Street, Staniford Street, Lomasney Way and Storrow Drive, gathered information on the availability of off-street parking which the area, particularly during the critical noon-time hour when the demand for outpatient parking at the Shriners Burns Institute begins to peak.

Although the survey has not been released, BTD (see Appendix B-3 for correspondence) indicated that the facilities had a peak occupancy rate of 86%. This is nearing the effective capacity of the facilities. However, in analyzing this data, the following facts must be taken into consideration.

- The data is the result of a one-day only survey. While the survey provides a "snapshot" of parking supply on the date surveyed, it does not account for variables such as peak shopping days at the two Charles Plaza facilities, hospital outpatient appointment patterns at the MGH facilities, or special events.

- According to the DPIR, six of the facilities in close proximity to the Shriners-Ten Emerson, the Charles River Lot and Garage (1 Emerson Place), Parkman Street, Fruit Street and Longfellow Place - have occupancy rates of greater than 90% and are essentially at their effective capacities.

- MGH's Ambulatory Care lot on North Anderson is dependent upon MGH's patient load since it serves as an overflow lot for the two MGH garages.

- Parking at Charles River Plaza is dependent upon the shopping center's demand and can not be considered a reliable source of long-term parking for the Institute.

- The effective capacity available at each facility should also be considered. The total supply of handicapped spaces and double-parked vehicles will impact available capacity.

In addition to the existence of the commercial off-street spaces, 71 metered parking spaces are located along Blossom Street between Cambridge Street and Storrow Drive, as well as four handicapped spaces between the Blackstone Apartments and the Burns Institute. In order to determine the capacity and utilization of these spaces, a field survey was conducted on October 2, 1991 between the hours of 11:00 AM and 2:40 PM. The survey sheets are included in Appendix B-3. The time period was selected to coincide with the Outpatient Clinic's hours of operation. It should be noted that the two meters located at the intersection of Cambridge Street were closed for storage of construction equipment all day while four meters in front of MGH were not available until 1:00 PM due to work being performed by Boston Thermal Energy Corporation. The spaces were observed every twenty minutes, or three times per hour.

According to the survey, there were no meters or handicapped spaces available during any of the field observations. An average of eight spaces turned over every 20 minutes. In addition, 21 meters, were occupied by the same vehicle throughout the survey period. The average duration at a meter was 1.8 hours. All four handicapped spaces were occupied by the same vehicle during each observation.

2.2.2 Existing Parking Demand

Parking demand for the Shriners Burns Institute is generated by employees, volunteers, members of the Board of Governors, users of the Auditorium and patients. Of the existing 124 off-site spaces owned or leased by the Shriners Burns Institute, only staff, volunteers and 16 (out of 21) Board members are allowed to park in the off-site spaces. No parking spaces are provided for volunteers.

In order to ascertain existing parking demand, and the ability of the supply to meet the demand, an extensive survey was conducted of the users. The results of the surveys, and an analysis of existing supply, are described in the following sections.

2.2.2.1 Employee Parking Demand

Currently, the Institute employs 210 medical, administrative, housekeeping and maintenance staff. There are 120 first shift employees. In addition to regular employees, approximately 60 researchers are assigned to the Institute. While not directly employed by the Shriners Burns Institute, they are equivalent to full time employees for the purpose of the parking analysis and work between 7:00 AM and 5:00 PM. Utilizing the daily auto use of 52.6%, together with the calculated auto occupancy rate of 1.2 passengers per car (see Section IV-3.1.3), a daily demand for 79 parking spaces has been calculated. In addition, a shift change factor of 20 employees has been calculated to account for those third shift employees departing late, second shift employees arriving early, and/or nurses working double shifts. Because of the double shift and third shift factors, all of these shift change cars are assumed to have single occupants. The shift change generates a demand for 11 spaces.

2.2.2.2 Volunteer Parking Demand

The volunteers are usually Shriners who donate three to eight hours per day, once or twice a week to the Institute. The volunteers receive no benefits except for parking. On average, approximately ten volunteers are working between 9:00 AM and 5:00 PM. According to the results of a transportation survey, 86.5% or nine of the volunteers arrive by auto.

2.2.2.3 Board of Governors' Parking Demand

The Institute is directed by a Board of Governors that consists of 21 regular, 11 emeritus, 1 associate and 15 honorary members. All members are eligible to attend the monthly Board meetings, and all regular Board members serve on standing committees that meet regularly. Thus, a conservative analysis is to assume that 40% of the total members can be found at the Institute on a regular basis. It should be noted, however, that the Board membership includes representatives of all 15 Shrine Temples in the Northeast, not just residents of Greater Boston. Therefore, it is difficult to expect a large percentage of Board members to rely upon public transportation.

2.2.2.4 Outpatient Parking Demand

Shriners Burns Institute presently has the capacity to examine 30 outpatients per day during Outpatient Clinic. The Clinics are held at least three times per week between the hours of 1:00 PM and 3:00 PM. The hospital also provides thirty beds for inpatients.

Currently, the Institute has an active list of 4,142 outpatients. The list continues to grow since burn victims require follow up surgery and treatment throughout their growth years and beyond. Therefore, many patients will be coming to the Institute two to three times a year. The Hospital's service area includes the entire Eastern United States, with

58% of the patients being Massachusetts residents. The Institute, however, has patients from other portions of the U.S., as well as Puerto Rico, the Virgin Islands, Canada, Central America, South America and Europe. In addition, the nature of the burn injury means that each acute care patient will become an outpatient for as many years as the healing process requires. The Institute is unable to accommodate the parking demand that the patients generate.

In order to determine the parking characteristics of outpatients and visitors, a transportation and parking survey was conducted in August and September 1991. In the survey, the parents or guardians of 222 outpatients and 38 surgical patients responded to a series of questions regarding their individual mode of travel. Table IV-2.6 summarizes the modal splits observed from the surveys. The survey summary sheet is included in Appendix B-4.

An analysis of the data confirms an assumption long held by the Shriners that the majority of all patient related trips are made by private automobile.

Since the physical impacts of severe burn injuries often serve as psychological and physical impediments to public transit use, MBTA use is lower than might be expected at the Massachusetts General Hospital or other urban hospitals. The patients arriving by taxi are often patients who have travelled to Boston by air, while the bus category represents intercity service such as Greyhound.

Once the mode of travel was determined, the survey identified the parking practices of those who drove. This is critical due to the lack of on-site or hospital owned parking for patients. Table IV-2.7 shows that although a significant number of people are utilizing the MGH garages, the most popular parking choice is an on-street meter. Following is a list of three reasons for the heavy use of on-street parking.

o Cost - A review of the surveys indicate that the majority of outpatient visits are over within one hour. Immediate family members visiting critically burned children who are inpatients will likely be at the Institute for a prolonged period of time, perhaps, even, remaining overnight. Therefore, parking in a commercial garage is a significant cost penalty for the patient's family.

o Proximity to Shriners Burns Institute - Because of the injuries involved, many of the patients are not able to walk great distances to the Hospital. While they can be dropped off at the entrance, the parent/guardian may not want to

TABLE IV-2.6
PATIENT PARKING NEEDS - MODAL SPLIT (%)
SHRINERS BURNS INSTITUTE

Travel Mode	Category of Patient	
	Outpatient	Inpatient
Car	67.6	63.2
MBTA	14.4	10.5
Bus	5.4	2.7
Taxi	3.1	10.5
Shriner Van	3.6	5.2
Other	5.9	7.9

TABLE IV-2.7
PATIENT PARKING (%)
SHRINERS BURNS INSTITUTE

Travel Mode	Category of Patient	
	Outpatient	Inpatient
Meter	40.7	66.6
Hawthorne Place Garage	9.3	4.2
MGH Garage	25.3	4.2
Other Garage	24.7	25.0

leave the child alone for a prolonged period. Therefore, many drivers will prefer to search for a vacant meter within immediate proximity to the Institute rather than have to walk more than two blocks from a garage.

- Availability of Supply - As noted before, the actual off-street parking capacity within the study area may be less than theoretical capacity.

Whatever the individual reason for the decision to park on-street, nearly half of all private cars driving outpatients to the Clinic are searching for on-street parking rather than using an off-street facility. Because of the low turnover in meters along Blossom Street, the need for drivers to search for parking results in a corresponding increase in vehicle miles travelled and congestion.

2.2.2.5 Auditorium Parking Demand

One of the primary functions of the Shriners Burns Institute is to provide training for medical personnel (doctors, nurses, EMTs, firefighters) on the latest techniques in treating pediatric burn emergencies. This requires conducting seminars and training sessions in the 196-seat auditorium on a regular basis. In addition, the auditorium is also used by the Massachusetts General Hospital for various conferences and seminars. In 1990, the auditorium was used on 135 days, or 54% of a typical 250-day work calendar.

The DEIR/DPIR estimated that 50 parking spaces would be required to meet demand. Both the Secretary and BTD questioned the assumption that 25% of all auditorium users would require a parking space. Therefore, a survey of auditorium users has recently been conducted. According to the results of the survey (Appendix B-5), 64% of attendees drive into Boston by automobile, 13% take transit, 18% walk from MGH or other local institutions. The remaining 5% arrived by private bus. This high auto usage reflects the large number of non-local medical officials (i.e., EMTs, firefighters, etc.) who attend educational seminars from throughout New England. Thirty-three percent (33%) of drivers park at an MGH garage, and 27% at on-street meters. At full capacity the auditorium has the potential to generate a demand for 125 spaces.

Table IV-2.8 summarizes the revised existing parking demand for the Institute. As noted previously, the available supply controlled by the Institute totals 127 spaces. However, existing demand is 281 spaces which leaves a shortage of 154 parking spaces.

TABLE IV-2.8
EXISTING PARKING DEMAND

Category	Gross Demand	% Auto Use	Required Spaces
First Shift Employees(1)	180	52.6%	79
Shift Change Factor	20	52.6%	11
Volunteers	10	86.5%	9
Outpatient	30	67.6%	20
Board(2)	48	40.0%	19
Family Visitors (30 Beds)	30	63.2%	19
Auditorium (196 Seats)	196	64.0%	125
TOTAL	514		281

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(1) 120 employees and 60 researchers are assigned to the day shift. Auto occupancy is 1.2 passengers/car.

(2) 21 Regular Board Members, 11 Emeritus Members, 1 Associate, 15 Honorary Members.

2.3 Public Transportation

The Shriners Burns Institute is accessible by public transportation, including rapid transit, commuter rail and bus service.

The nearest rapid transit station to the hospital is the MBTA's Charles/MGH Red Line station located at Charles Circle, approximately four blocks from the hospital. The Red Line provides direct access to the inner northwest as well as the southeast suburbs and connections to the Green Line at Park Street. In addition, the Red Line provides direct access to the Porter Square commuter rail station which serves the northwest suburbs. There is no local bus service provided by the MBTA along Cambridge Street.

Additional rapid transit and commuter rail service is provided to the study area at North Station, where both the Orange and Green Lines have stops. Commuter rail service to the north and northwest is also available at North Station. Commuter rail service to the southwest and western suburbs is available at South Station which is accessible via the Red Line.

3.0 PROBABLE PROJECT IMPACTS

3.1 Traffic Impacts

To accurately assess the impact of the project on the surrounding transportation system, the base or "No-Build" volumes must be developed for the future study year. In addition, the estimation of vehicular trips to be generated by the expansion of Shriners Burns Institute must be determined.

The garage entrance/exit from the proposed facility will be from Blossom Street. This represents a change from the PNF and ENF, which identified William Cardinal O'Connell Way as the access and egress point. The change to Blossom Street will reduce the impacts of the project on William Cardinal O'Connell Way. A break in the median along Blossom Street will be pursued so that vehicles entering and exiting the site will not be required to make U-turns. The median break should not have any detrimental effects on traffic flow, as discussed hereinafter.

All loading and delivery activities will be conducted at the rear of the new building, in approximately the same location where these activities presently occur. The number of loading docks will increase from one to three and they will be of a more generous size to allow for improved loading and unloading. Delivery trucks will drive to the loading area off of William Cardinal O'Connell Way by either Blossom Street or Staniford Street. The frequency of deliveries to the hospital will be similar to the number presently being conducted to the facility.

3.1.1 No-Build

In accordance with the Scoping Determination issued for this project, only two alternatives have been analyzed for traffic impacts: the "No-Build" and "Build" alternatives for the design year. The year 1994 was originally selected as the design year for the DPIR to reflect the fact that Phase I of construction, the medical levels above the truss, include all outpatient services, the major generator of new trips.

The No-Build alternative assumes that any presently active developments within the study area are completed and occupied, with the exception of the Shriners Burns Institute addition. Traffic generated by these projects, as well as an annual background traffic growth of 1.0%, is added to the existing traffic volumes to develop the No-Build condition.

According to the BRA, the Massachusetts General Hospital's Tower II is the only additional project within the study area which has either submitted a proposal or received approval. According to the DEIR prepared for that project (EOEA #5825, HMM Associates, Inc., November, 1985), the 12-story research building is expected to generate approximately 80 person trips during each peak hour. Of these trips, 40%, or 32, will be by automobile.

The vehicular trips generated by the MGH project were distributed throughout the study area roadway network based on the distribution pattern contained in the DEIR. Traffic volumes for the No-Build alternative are shown in Figures IV-3.1 and IV-3.2.

3.1.2 Build

This scenario assumes that the new vehicle trips generated by the Shriners Burns Institute expansion project are added to the No-Build traffic network. The number of new trips on the roadway network during the peak hours will depend on a number of factors, including the anticipated increase of employees and patients, their mode of travel, and their arrival and departure times to and from the facility.

The proposed Shriners Burns Institute will replace the existing facility built in the late 1960's. The overall project consists of approximately 200,000 sf of medical floor space to replace the existing 80,000 sf Shriners Burns Institute. In addition, a 100-car below-grade parking garage is being negotiated, primarily for the use of outpatients and visitors during the daytime hours. There will be no increase in the number of inpatient beds.

According to hospital officials, the expansion will result in a moderate increase of 12 medical and administrative staff and 50 research staff. In addition, hospital officials estimate that the outpatient clinic, which has a current daily capacity of 30 patients, will increase to 75 outpatients/day. Therefore, the net increase in trips to be generated by the proposed expansion will be due only to the increase in hospital employees, researchers, and outpatients to the clinic. Since the number of inpatient beds will remain the same, no increase is expected in the number of visitors to the hospital. The number of volunteers also is not expected to increase over existing levels.

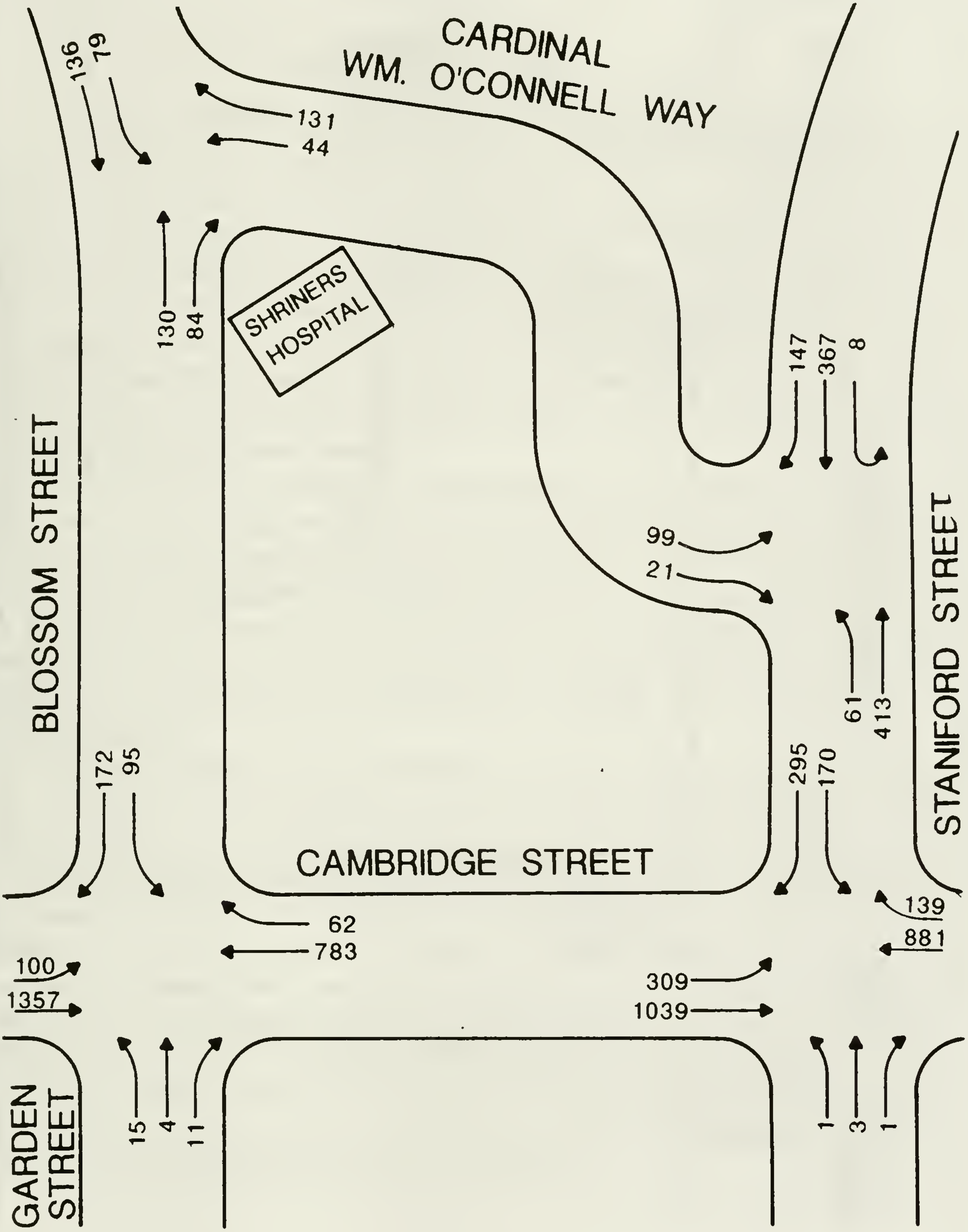

FIGURE IV-3.1
1994 NO-BUILD AM PEAK HOUR TRAFFIC VOLUMES

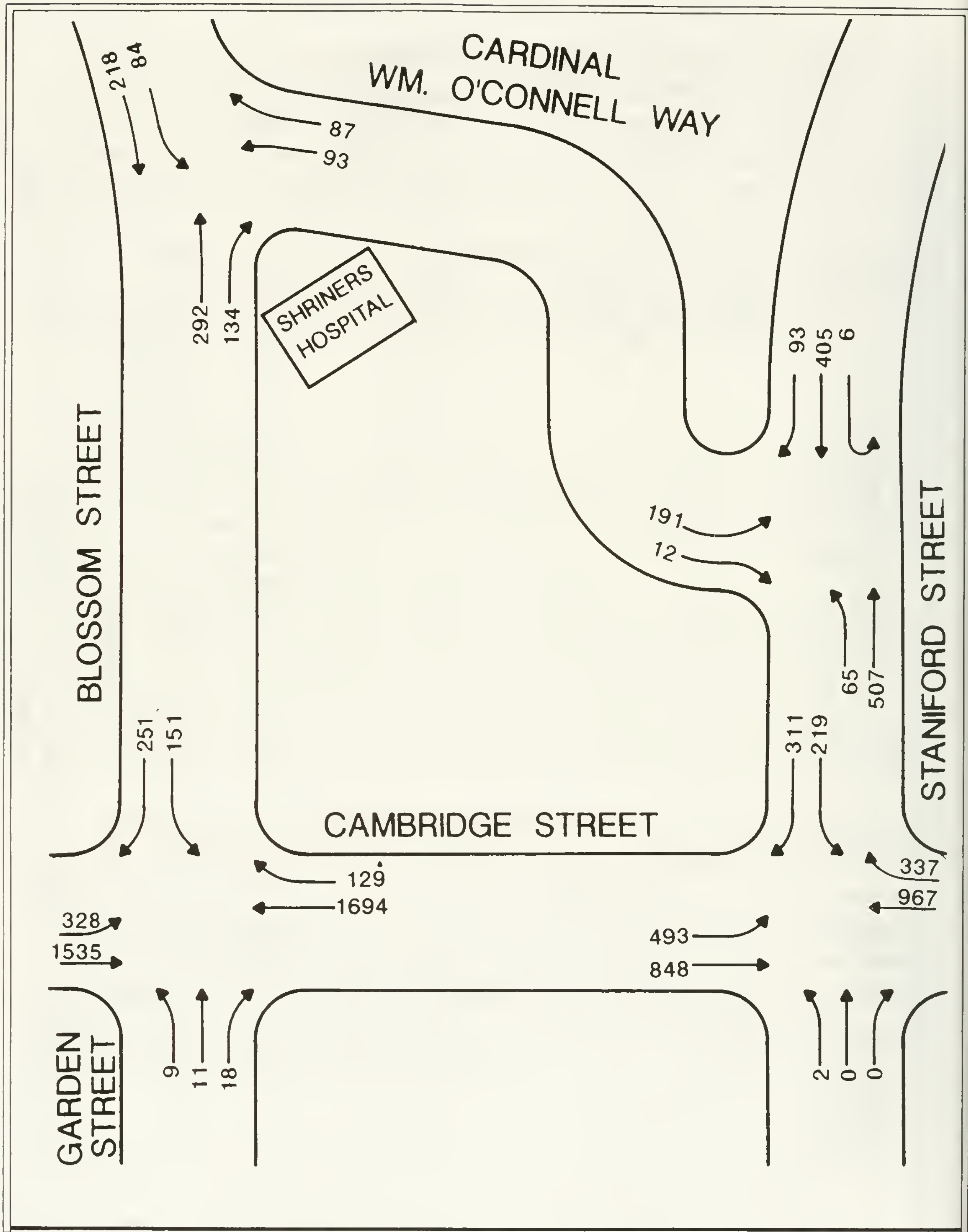

FIGURE IV-3.2
1994 NO-BUILD PM PEAK HOUR TRAFFIC VOLUMES

3.1.3 Site Traffic Generation

Vehicle trips to and from a site can be estimated by several means. One option is to use data published by the Institute of Transportation Engineers (ITE) in their manual "Trip Generation" (5th Edition, 1991). This publication contains trip generation rates for a wide variety of land use types, including hospitals. These vehicle trip rates are obtained from nationwide studies and are normally suitable for design purposes (see Appendix B-5).

A second option is to develop site-specific trip generation data. This method can be particularly accurate when applied to an existing facility undergoing expansion, such as with the Shriners Burns Institute. In this manner, trip generation rates can be developed which account for site-specific characteristics, such as public transportation use and existing demand management measures.

Each of these two methods have their advantages and disadvantages. However, the ITE rates for hospitals are traditionally collected from large general purpose facilities in suburban areas and are representative of a national average. In addition, the ITE manual provides separate categories for hospitals and clinics, but not for a combination of both, such as the Shriners Burns Institute. If the ITE data is used as it pertains to the amount of floor area to be constructed, the resultant increase in vehicular trips would be far greater than could be expected from an additional 62 employees and researchers and 45 outpatients per day.

In order to address this issue, the Boston Transportation Department (BTD) called for the collection of actual employee trip data from the hospital. Normally, for an existing facility, traffic counts would be conducted in order to determine the number of trips presently being made to and from the site. The resulting data then would be extrapolated to determine the volume of new trips. However, in this case, an intensive survey was performed in order to determine the modal split by employees, inpatient visitors and outpatients. Results of the survey indicate that of the current employees, 41% arrive at the site during the morning peak hour. During the afternoon peak hour, approximately 29% of the total employees leave the hospital (see Appendix B-5). Extrapolation of the data to the anticipated increase of 62 employees and researchers results in the estimated number of net person trips shown on Table IV-3.1. The table also provides a comparison to trips anticipated using ITE data, based on employees.

TABLE IV-3.1
EMPLOYEE VOLUMES
SHRINERS BURNS INSTITUTE

	AM PEAK HOUR		PM PEAK HOUR		DAILY	
	Enter	Exit	Enter	Exit	Enter	Exit
ITE*	16	6	6	15	155	155
Site Specific**	25	1	1	18	62	62

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* Institute of Transportation Engineers (ITE) rates for hospitals. (Trip Generation, 5th Edition, 1991). Volumes represent vehicular trips based on anticipated increase of 62 employees.

** Person-trips based on anticipated increase of 62 employees with 41% arriving during the morning peak hour and 29% exiting during the afternoon peak hour. Table IV-3.4 presents vehicle-trip increases.

To properly quantify the actual vehicular traffic volumes, the average vehicle occupancy rate, as well as transit and pedestrian trips, must be accounted for. According to the results of the on-site survey, an average vehicle occupancy rate of 1.2 passengers/auto work trip can be expected from the employees and researchers. In addition, a modal split was determined by the on-site survey and as shown on Table IV-3.2. Application of these factors result in the net vehicular trip generation for employees as shown on Table IV-3.5.

In addition to employee trips, the proposed expansion will increase the number of trips generated by the outpatient clinic. Presently, the clinic is conducted three times per week, with approximately 30 patients attending each clinic. Upon completion of the proposed project, the patient load will increase to 75 patients per day.

A transportation and parking survey of outpatients and visitors also has been conducted by Shriners Burns Institute to determine the number of trips currently being made by automobile. The results, as previously provided in Table IV-2.6 and as shown on Table IV-3.3, indicate that the majority of all patient-related trips are made by private automobile.

Based on the modal share given in Table IV-3.3, and the anticipated outpatient increase of 45 patients per day, an additional 60 trips will be generated per day (Table IV-3.4). Clinic related trips will not occur during the peak morning commuting hour since the clinic does not open until well after 9:00 AM. Although the Clinic traditionally closes by 3:00 PM, it is assumed in Table IV-3.5 that 10 clinic-generated vehicle trips will exit the garage during the afternoon peak hour. This provides a conservative or "worst case" scenario.

While the garage is designed to meet the needs of patients and not employees, the requirement of preparing a conservative analysis requires that a reasonable portion of total trips to the hospital be assigned to the garage during the two peak hours. This is partially true for evening and night-shift employees who will park in the garage for security reasons. Utilizing the results of the employee surveys, as well as information provided by the Hospital Administrator, it was assumed that all new employee trips during the peak hours will utilize the new garage. Visitors, volunteers and Board Members' trips to the new facility are currently made during the off-peak hours. No increase in peak hour trips is expected from these non-employee, non-patient categories.

TABLE IV-3.2
EMPLOYEE MODAL SHARE
SHRINERS BURNS INSTITUTE

MODE	AM PEAK HOUR	PM PEAK HOUR	DAILY
Auto	48.8%	53.3%	52.6%
Transit	45.0%	45.0%	40.2%
Walk	5.0%	1.7%	5.7%
Bicycle	1.3%	0.0%	0.5%
Other	0.0%	0.0%	1.0%
TOTAL	100.0%	100.0%	100.0%

TABLE IV-3.3
PATIENT MODAL SHARE
SHRINERS BURNS INSTITUTE

MODE	OUTPATIENT	INPATIENT VISITORS
Auto	67.6%	63.2%
Transit	19.8%	13.2%
Taxi	3.1%	10.5%
Shriners' Van	3.6%	5.2%
Other	5.9%	7.9%
TOTAL	100.0%	100.0%

TABLE IV-3.4
PERSON-TRIP INCREASE BY MODE
SHRINERS BURNS INSTITUTE

	AM PEAK HOUR		PM PEAK HOUR		DAILY	
	Employees	Outpatients*	Employees	Outpatients	Employees	Outpatients
Auto	13	0	10	10	64	60
Transit	11	0	8	3	48	18
Walk	1	0	1	0	8	0
Bicycle	1	0	0	0	2	0
Shriners' Van	0	0	0	0	0	4
Other	0	0	0	2	2	8
TOTAL	26	0	19	15	124	90

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* Outpatients and parent/guardian considered as one person-trip.

TABLE IV-3.5
NET INCREASE IN VEHICLE TRIPS
SHRINERS BURNS INSTITUTE

CATEGORY	AM PEAK Enter	AM PEAK Exit	PM PEAK Enter	PM PEAK Exit	DAILY Enter	DAILY Exit
Employees*	10	1	1	8	27	27
Outpatients/** Visitors	0	0	0	10	30	30
Board	0	0	0	0	0	0
Volunteers	0	0	0	0	0	0
Auditorium	0	0	0	0	0	0
TOTAL	10	1	1	18	57	57

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* Assumes vehicle occupancy of 1.2 passengers/vehicle.

** Outpatients and parent/guardian considered as one person-trip.

3.1.4 Trip Distribution and Assignment

The distribution of trips to and from a development is generally a function of location of various land use types as well as area street network orientation. Regional distribution used in this study is based on the distribution contained in the DEIR/DPIR prepared for Massachusetts General Hospital's proposed Towers 1 and 2.

Based upon the above distribution and trip assignments, trips to the new garage were determined. Figure IV-3.3 provides the morning and afternoon increases in traffic volumes due to the new facility. Figure IV-3.4 provides the daily increases in traffic volumes.

Because of recent scheduling changes, the project is not expected to be completed until 1995. However, a review of anticipated peak hour No-Build and Build volumes show that a one percent increase in traffic would have negligible impacts on volumes. As an example, volumes at Blossom Street's intersection with William Cardinal O'Connell Way would increase by 5 vehicles in the morning peak hour and by 9 in the afternoon. Since the Build condition traffic operations were not identified as an issue by the BRA, the 1994 volumes have continued to be used as shown in Figures IV-3.1, IV-3.2, IV-3.5 and IV-3.6.

As shown in Table IV-3.6, the addition of project-generated traffic will not noticeably affect operations at any of the study intersections during either the morning or afternoon peak hours. Levels of service will remain the same for the No-Build and Build conditions given the small increases in peak hour traffic. In addition, the changes in reserve capacity and delay for each of the intersections is minor and will not be noticeable.

At the William Cardinal O'Connell Way intersections with Blossom Street and Staniford Street, all movements onto William Cardinal O'Connell Way will operate at LOS A during the peak hours. Motorists turning from William Cardinal O'Connell Way onto Staniford Street will experience lengthy delays during both peak hours, however, this condition occurs regardless of the Shriners expansion.

Only slight increases in delay will occur at the Blossom Street intersection with Cambridge Street during the two peak hours. The increase will be less than 1/2 second and is not noticeable as the intersection will continue to operate at LOS D. The same is true at the Cambridge Street/Staniford Street intersection which will operate at LOS F during the afternoon peak hour. The increase also will be less than one-half second and will not be noticeable.

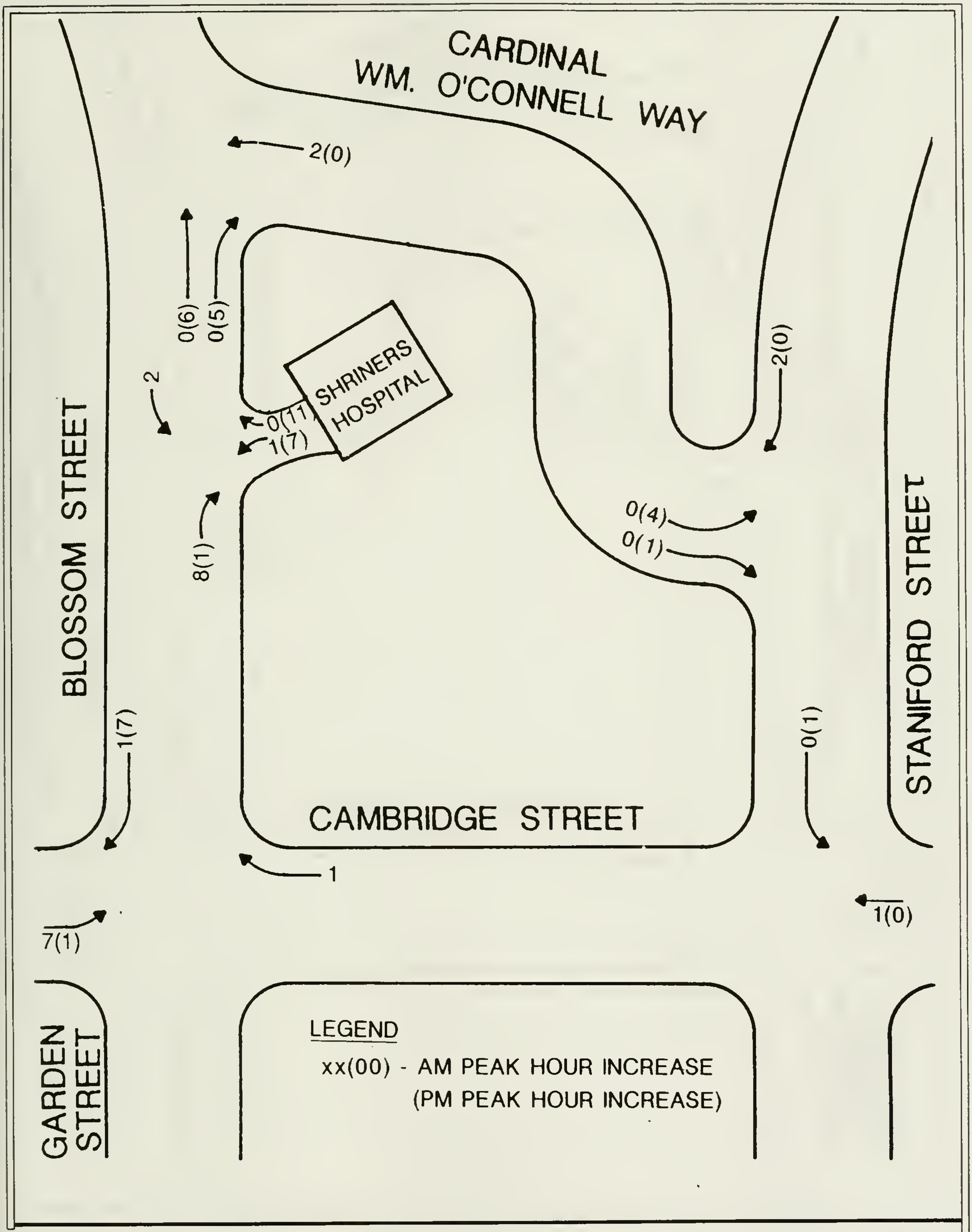

FIGURE IV-3.3
TRIP DISTRIBUTION

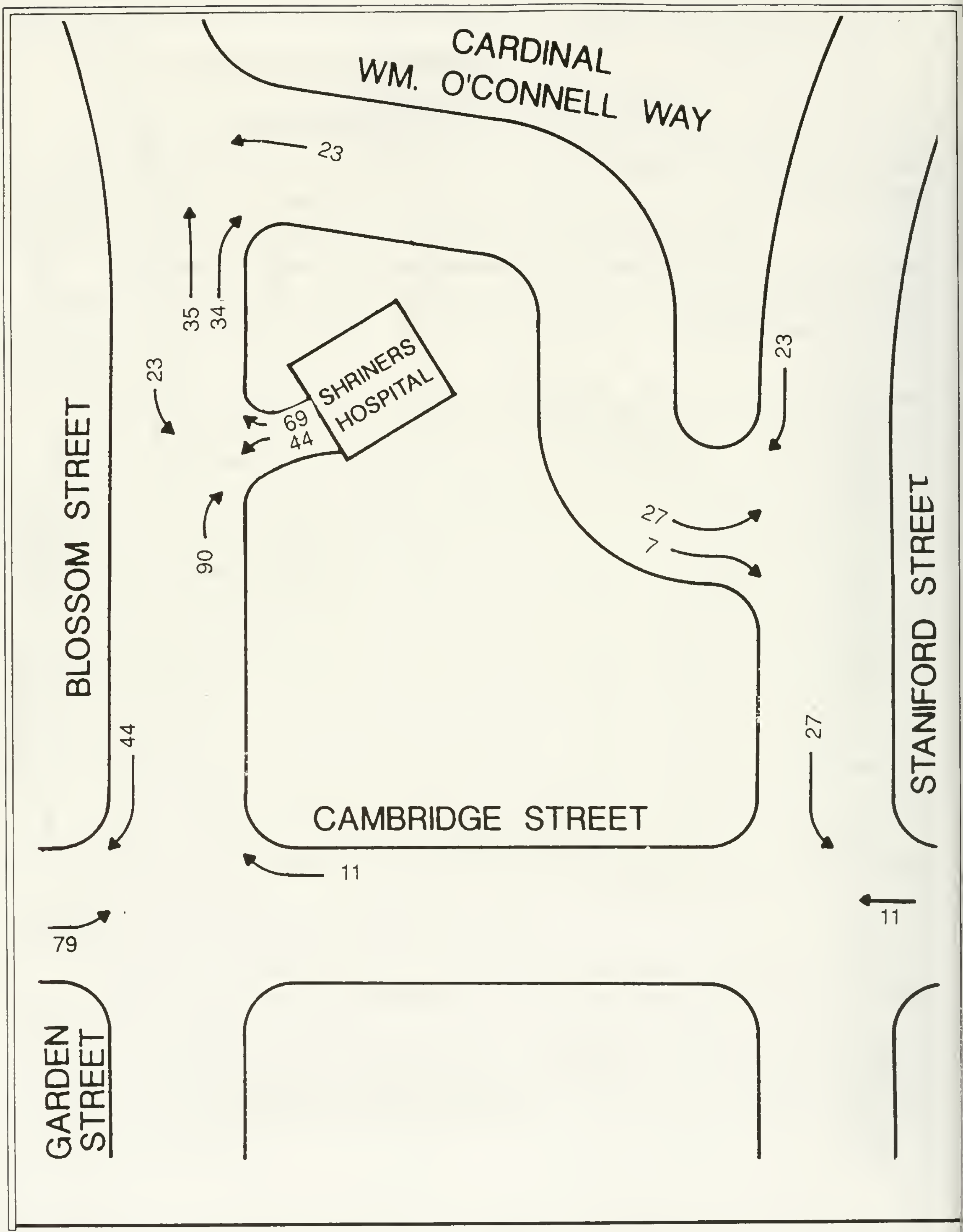

FIGURE IV-3.4
DAILY TRIP ASSIGNMENTS - NEW TRIPS

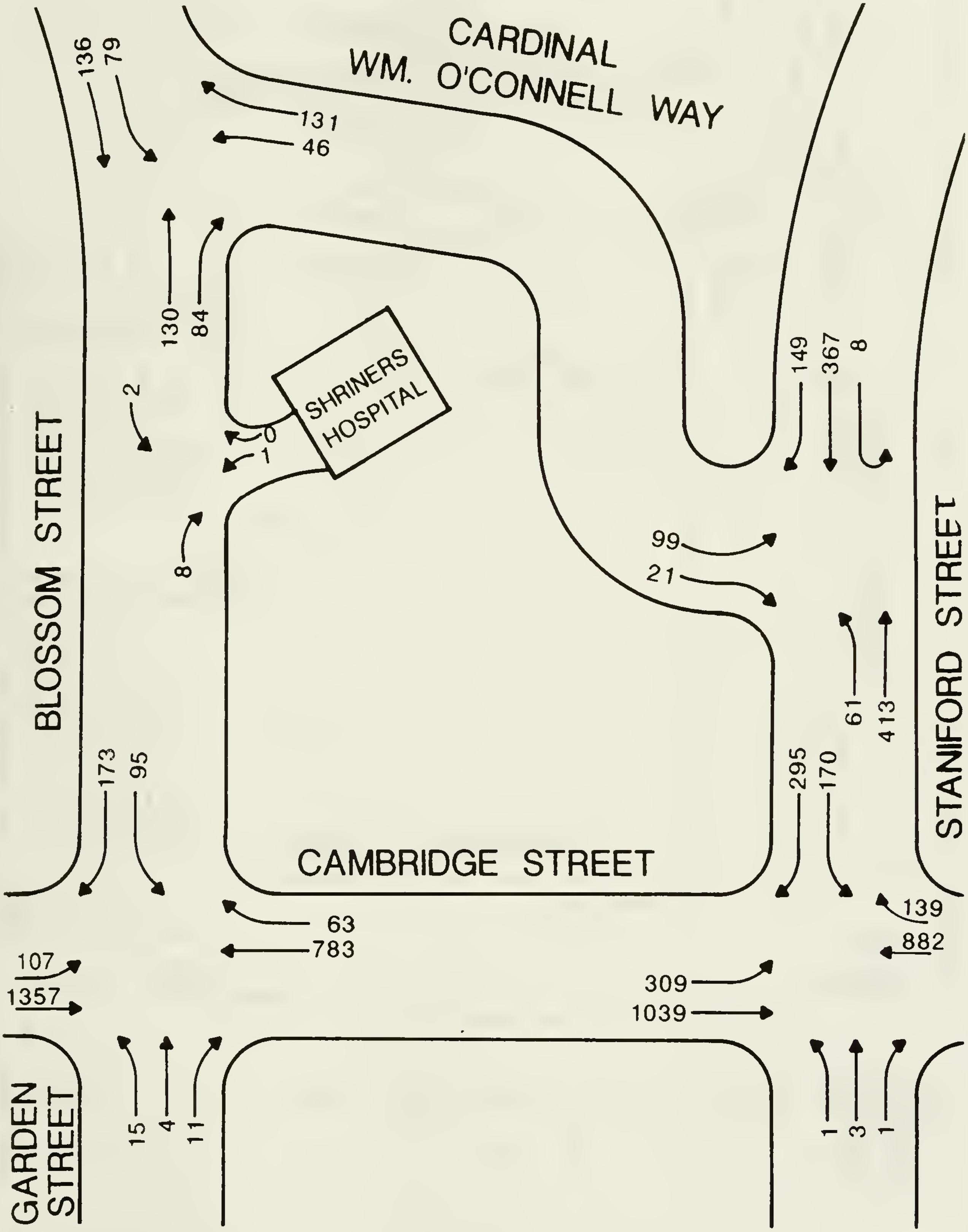

FIGURE IV-3.5
1994 BUILD AM PEAK HOUR TRAFFIC VOLUMES

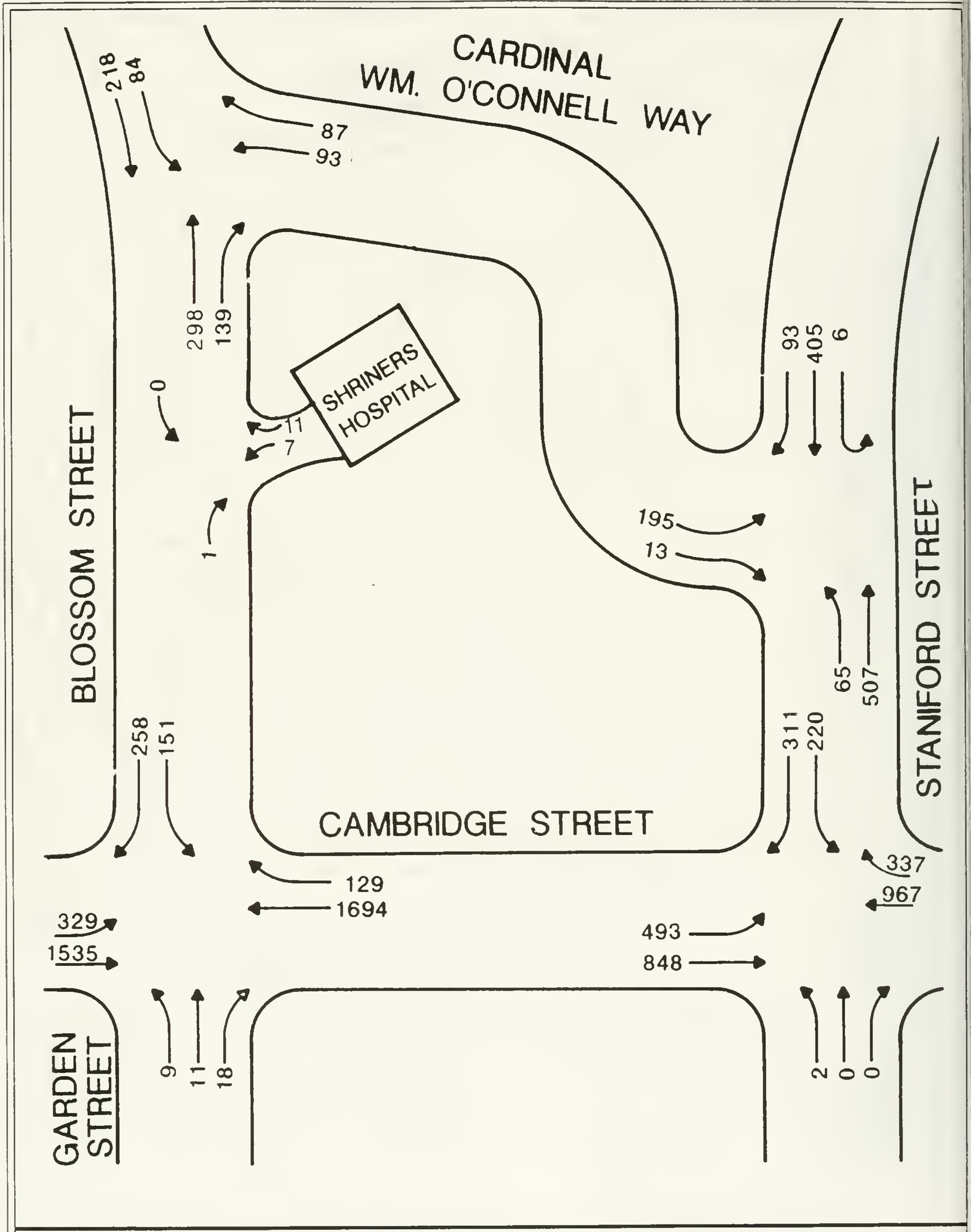

FIGURE IV-3.6
1994 BUILD PM PEAK HOUR TRAFFIC VOLUMES

TABLE IV-3.6
FUTURE 1994 OPERATING CONDITIONS
SHRINERS BURNS INSTITUTE

	AM PEAK HOUR				PM PEAK HOUR			
	No-Build		Build		No-Build		Build	
Unsignalized Intersection	R.C.	LOS	R.C.	LOS	R.C.	LOS	R.C.	LOS
Blossom Street/William Cardinal O'Connell Way								
- Left turns from Blossom St. SB	795	A	795	A	553	A	546	A
- All moves from William Cardinal O'Connell Way	562	A	541	A	147	D	136	D
Staniford Street/William Cardinal O'Connell Way								
- Left turns from Staniford St. NB	504	A	500	A	483	A	482	A
- Left turns from Staniford St. SB	623	A	623	A	552	A	552	A
- All moves from William Cardinal O'Connell Way	10	E	8	E	-133	F	-138	F
Garage Entrance/Exit on Blossom Street								
- Exit from Garage	-	-	1015	A	-	-	891	A
Signalized Intersection	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
Cambridge Street/Blossom Street	6.1	B	6.2	B	39.4	D	39.8	D
Cambridge Street/Staniford Street	14.3	B	14.3	B	65.3	F	65.6	F

As previously noted, the analysis of both of these intersections assumes only two lanes of travel are available on Cambridge Street, in addition to limited lengths for right-turns onto Staniford and Blossom Streets. Existing regulations prohibit any form of parking on both sides during the critical afternoon peak period, however, numerous violations were noted at the time of this study, and the intersections were modeled assuming only two lanes are available in each direction. Enforcement of the existing regulations will result in greatly improved operations at both of these locations. Analyses reveal that the Staniford Street intersection could operate at a LOS C, while the Blossom Street intersection could function at a LOS B with 14 seconds of delay.

Analysis of the garage entrance and exit onto Blossom Street reveals that a LOS A will be provided during both peak hours, with and without a median break. Providing a break will eliminate the need for U-turn movements on Blossom Street. In addition, vehicles turning into and out of the garage will have little or no affect on through vehicles on Blossom Street.

3.2 Parking Impacts

Upon completion of the proposed project, the number of employees and researchers will increase by 62. All of the new employees have been assigned to the day shift for the purposes of this analysis. The proposed project will also increase the number of seats in the auditorium from 196 to 200. Neither of these increases will have significant impacts on parking demand. The most significant change in parking demand will occur as a result of outpatient services, where the expansion of the facilities will allow an additional 45 patients to be treated on a daily basis. Table IV-3.7 was developed based on the assumptions contained in the analysis of existing data. The percentages of auto use are as shown on Table IV-2.9, Existing Parking Demand.

As seen from Table IV-3.7, net parking demand under the Build condition is 343 spaces, a shortage of 213 spaces without construction of additional parking. As currently proposed, the addition of a new 100-space on-site garage, which is being negotiated, together with maintaining 124 off-site spaces, will result in a total supply of 224 spaces (the three on-site spaces that currently exist will become part of the garage total), a shortfall of 119 spaces.

TABLE IV-3.7
1994 BUILD PARKING DEMAND
SHRINERS BURNS INSTITUTE

Category	Gross Demand	% Auto Use	Net Demand
First Shift Employees(1)	242	52.6%	106
Shift Change Factor	20	52.6%	11
Volunteers	10	86.5%	9
Outpatient	75	67.6%	51
Board of Directors	48	40.0%	19
Family (1 Bed)	30	63.2%	19
Auditorium	200	64.0%	128
TOTAL DEMAND	625		343

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(1) At full build there will be 132 first shift employees and 110 researchers. Auto occupancy is 1.2 persons per car.

3.3 Public Transportation Impacts

Based on the modal splits discussed previously, it may be anticipated that 21 of the new employees will use public transportation to and from work on a daily basis, while 9 of the outpatients, along with accompanying family members also will use public transportation. Most of these new trips will be made during off-peak hours, when the public transportation system can readily accommodate these minor increases.

3.4 Service Traffic Impacts

Currently, the Institute receives an average of sixteen (16) service deliveries daily. The majority of these deliveries (56%) are made by step-vans or smaller vehicles. These include food service, linen, courier services, medical supplies and mail. Of the remaining deliveries, 31% are by small trucks (such as milk deliveries) and 13% by 45-foot trailers.

At the present time, these vehicles are required to use the one loading dock located off William Cardinal O'Connell Way. Because of the limited access area, the larger vehicles tend to disrupt vehicular and pedestrian traffic along both William Cardinal O'Connell Way and the pedestrian way behind St. Joseph's Church. If a truck is already at the dock, other trucks are required to wait along William Cardinal O'Connell Way.

The proposed project will serve to mitigate these problems in a number of ways:

1) The new loading area will be enclosed and set back to allow trucks to enter without blocking vehicular and pedestrian traffic.

2) The service doors will mitigate noise and fume impacts to Regina Cleri, St. Joseph's Rectory, and William Cardinal O'Connell Way.

3) Additional loading docks will minimize, if not eliminate, the need for trucks queueing along William Cardinal O'Connell Way. This is further reinforced by the elimination of the three parking spaces behind the existing building.

4) The increased storage space in the new facility will allow the Institute to store more supplies. This would mean that additional deliveries of supplies for increased outpatient services, medical research, and office space would not

necessarily be required. In fact, the number of scheduled deliveries could, potentially, be reduced due to increment storage capacity. Although additional waste will be generated by the new facility, the number of truck pick-ups is expected to be the same.

3.5 Construction Impacts

3.5.1 Vehicular Trips

The construction work will require approximately 33 months, with an anticipated weekday work shift of 7:00 AM to 3:30 PM, although steel erection, foundation preparation, concrete pouring, and masonry work may extend to 5:30 PM on weekdays. The number of workers required during the construction period will vary, with an estimated average daily work force of approximately 200 workers during the peak of construction. Also assuming the daily modal split identified in Table IV-3.2, the maximum of 200 workers translates to an estimated 105 vehicle trips arriving between 6:00 and 7:00 AM and departing between 3:00 and 4:00 PM (except as noted above). As the construction workers usually arrive and for the most part will depart before the commuter peak hours, the construction traffic is not expected to have a significant impact on the peak hour traffic. Parking for construction workers will not be provided by the Institute on-site. Rather, the Institute will work with the contractor to encourage all workers to utilize public transportation whenever possible, with the goal being a modal split similar to the Hospital's employee split. To accomplish this, efforts will be made to secure parking in close proximity to outlying transit stations for parking by construction workers. Other measures to discourage the use of automobiles by construction workers are presented in the Mitigation section of this report (see Section IV-4.0).

3.5.2 Construction Vehicle Routings and Volumes

At the present time, Shriners Burns Institute does not know the geographical distribution of truck deliveries. As a result, a comprehensive plan to handle trucking activity from any direction cannot be developed until such time as the Construction Management Plan is developed with the Boston Transportation Department. However, based upon knowledge of the local and regional network, certain general assumptions regarding routing and volumes can be developed. In general, trucks from the south and west are expected to exit the Central Artery (Route I-93) at the North Station exit. These construction vehicles will proceed immediately to the site via Causeway Street, Staniford Street, Cambridge Street and Blossom Street. Usually vehicles arriving from the north along either the Tobin Bridge or I-93 would exit onto Storrow Drive and arrive at the site via Cambridge and Blossom Streets from Charles Circle. However, because of potential impacts from the Central Artery project, these trucks might also be required to either enter from Cambridge or the North Station area. Vehicles exiting the site will be directed toward Cambridge Street, Staniford Street, and the Route I-93 on-ramps. Construction vehicles will not be permitted to use William Cardinal O'Connell Way as a route to and from Staniford Street.

The number of trucks during the construction period will vary. On average, over the course of the demolition and construction phase, truck volumes of 10 to 12 arrivals and 10 to 12 departures per workday are expected. Assuming an even distribution over an 8-hour day, this translates to approximately two arrivals and departures per hour. The traffic impacts of these trips is expected to be negligible.

4.0 MITIGATION AND MONITORING

4.1 Introduction

The recommended management and mitigation plan presented in this final section of the report consists of travel demand management strategies, traffic operations improvements, and other recommendations to support the programmed growth of the hospital. None of these actions, however, are prerequisites to acceptance of the Shriner's proposal. In addition, any public improvements should only be adopted after sufficient public review to ascertain City and neighborhood feasibility.

4.2 Traffic Improvements

4.2.1 Intersection Improvements

The above analyses indicate that the expansion of the Shriners Burns Institute will generate approximately 11 additional vehicle trips during the morning peak hour and approximately 19 new vehicle trips during the afternoon peak hour. Intersection capacity analyses were conducted under three scenarios: Existing (1991), 1994 No-Build and 1994 Build. Results showed that levels of service for all intersections under the No-Build condition will be maintained under the Build scenario.

One potential improvement would be changing the existing traffic flow on William Cardinal O'Connell Way from a two-way flow to one-way. On the surface, the most appropriate mitigation measure for this intersection would appear to be making William Cardinal O'Connell Way one-way westbound between Staniford Street and Blossom Street. The positive impact of this measure would be the elimination of the existing and projected queues along William Cardinal O'Connell Way at Staniford, as well as left turns from Blossom Street onto William Cardinal O'Connell Way. The left-turn movement from William Cardinal O'Connell Way across two lanes of Staniford Street's traffic would be eliminated as well. Improvements to delay times at both ends of William Cardinal O'Connell Way could be expected.

The increase in peak hour trips a either intersection is minimal. Project-created decreases in reserve capacity for vehicles turning onto Staniford Street range from 2 passenger cars per hour (pcph) in the morning to 5 pcph in the afternoon.

In addition, traffic currently entering William Cardinal O'Connell Way from Blossom Street, 163 during the morning peak hour under the Build condition and 223 in the afternoon, would be forced to choose alternative routes. This would mean increased through traffic on Blossom Street as well as more trips through Cambridge Street's intersection with Blossom Street and Staniford Street. Eastbound traffic would be diverted to the above intersections or to Charles Street Extension, Martha's Way, and Lomasney Way to reach Staniford Street. Finally, pedestrian safety could be compromised through increased speed if vehicular conflicts are removed.

4.2.2 Pedestrian Safety

As noted in Section III, the study area contains a number of popular pedestrian routes. These include the path behind the Regina Cleri and St. Joseph's, William Cardinal O'Connell Way and Blossom Street. For residents of Charles River Park as well as Shriners employees using the Hawthorne Place garage, accessing these routes require crossing William Cardinal O'Connell Way. To access the MGH, pedestrians must cross four travel lanes on Blossom Street.

In order to mitigate these pedestrian safety issues, the Shriners have investigated potential measures for implementation. One measure suggested by the Trustees of Hawthorne Place was installation of a traffic signal at the intersection of William Cardinal O'Connell Way and Blossom Street. A preliminary review of the Manual of Uniform Traffic Control Devices indicates that none of the required warrants for installation of a traffic signal have been met.

However, even though a pedestrian traffic signal may not be warranted at this time, the Shriners will agree to construct new crosswalks along William Cardinal O'Connell Way at the access point to the existing pedestrian paths, and across Blossom Street in front of the Institute.

4.3 Demand Management

4.3.1 Transit Subsidies for Employees

Transit subsidies, especially when combined with increased parking prices, can have a direct effect on mode choice. Employee transit subsidies are becoming increasingly prevalent. Presently, while 45 transit passes are sold at Shriners Burns Institute each month, the hospital does not subsidize any portion of the cost. In order to increase use, the hospital will implement a subsidy program. The level of subsidy will be similar to the formula being developed by the Massachusetts General Hospital.

4.3.2 Areawide Ridesharing Coordination

The hospital will promote ridesharing and transit usage through use of the bulletin boards. Shriners also will provide brochures and other information to new employees. Because of the small number of employees involved, a program limited to Shriners Burns Institute might have a negligible impact by itself. Therefore, the most effective strategy will be for Shriners to cooperate with the Massachusetts General Hospital's (MGH) Commuter Services Program in developing a joint strategy. Discussions between the two institutions have already begun. As a result, the Shriners employees will ultimately be able to participate in the larger MGH program. In addition, 5 spaces for use by participants will be reserved in the new facility.

4.3.3 Flexible Work Schedules

Flexible work schedules can reduce traffic congestion by spreading a given number of daily vehicle trips more evenly and reducing peak-hour volumes. By allowing workers to adjust their commuting schedules, flexible work hours sometimes may facilitate carpool formation.

The hospital is committed to flexibility in work schedules to meet its own objectives as well as those of the transportation system. Alternative work schedules already exist at Shriners Burns Institute. Physicians come and go as needed, and researchers often set their own (irregular) hours. Clerical employees work staggered hours as well.

In addition, the above traffic analysis was based on the assumption that 40.7% of employees currently using transit during the peak hours will continue to do so. Therefore, the traffic mitigation plan proposed by the proponent also includes continued efforts at reducing the use of single occupancy vehicles by employees through the continued promotion of public transportation use and the sale of "T" passes on-site.

4.4 Parking Mitigation

Currently, 127 reserved parking spaces are available for employees, volunteers, and Board members of the Shriners Burns Institute. Only three of the spaces are located on site, at the rear of the Institute; 114 spaces are located at the adjacent Hawthorne Place

Garage, 104 of which the Institute owns outright; and 10 are leased at the Charles River Park garage on Lomasney way. No parking is available for outpatients or visitors. However, the analysis of outpatient generated parking demand indicates that approximately 2/3 of all outpatient trips are made by automobile. When existing patient demand is accounted for, the analysis has demonstrated that the Institute has a parking shortfall of 154 spaces. Upon completion of the Replacement Facility, the increase in employees, researchers and outpatients will create a demand for 59 additional spaces, leaving an overall shortfall of 213 spaces without construction of the proposed garage.

The main transportation related concern raised by neighborhood residents has been to reduce the total number of parking spaces available for use by the Institute. Original plans called for construction of a 150-space garage and the maintenance of all 124 off-site spaces, resulting in a total supply of 274 spaces. The FEIR proposed to reduce this supply to 225 spaces by constructing 133 spaces in the garage and maintaining 92 in the Hawthorne Place Garage.

Since submission of the FEIR, the Shriners Burns Institute has further analyzed the assumptions regarding parking supply and demand. This analysis is discussed below.

o Employees

The DEIR/DPIR assumed an auto occupancy rate of 52.6%. This resulted in a Build demand of 126 spaces, including a shift change factor of 20 employees. However, this 52.6% modal share is the daily share achieved at the Institute. If first shift employees were assumed to have an auto usage rate of 50%, a composite of current AM and PM modal shares, the Institute would require only 110 employee spaces. An additional 5 spaces will be reserved for use by employees participating in a ridesharing program. While 50% is higher than the 45% to 48% share which BTD prefers, it is reflective of the travel patterns of medical personnel who often work varied shifts.

o Board and Volunteers

The make-up of the Board and volunteers requires availability of parking. However, a total supply of 25 spaces will meet demand on a regular basis as opposed to the 28 contained in the DEIR/DPIR.

- Auditorium

  A careful review of the auditorium data indicates that despite the 64% auto use, the auditorium is not used daily, and when in operation, is not necessarily at capacity. Therefore, parking spaces do not have to be reserved for this use on a daily basis. However, the fact remains that the Institute's educational forum provide an excellent public benefit for medical personnel throughout New England, and that for many users, no viable alternatives to the private automobile exists for trips to Boston.

- Patients

  As already noted, 70 spaces are necessary to meet the projected patient needs in 1994. This assumes that outpatient growth will not exceed 75 patients per day. However, the expanded outpatient facilities will make it possible that more patients could be scheduled at certain times, particularly if demand continues to grow. This demand is fueled, in part, by continued advances in medical technology which makes it possible to treat inpatients quicker.

  In order to provide for growth in patient services, as well as meet demand generated by outpatient scheduling, it is now proposed that 5 parking spaces be designated as overflow spaces available for patient family members and visitors.

  Based upon the above assumptions, the Shriners Burns Institute is negotiating to maintain a total supply of 224 spaces, with 100 spaces in the on-site garage, and 124 spaces off-site.

4.5 Construction Management

Shriners Burns Institute will negotiate and sign a construction management agreement with the BTD. The first meeting in this process was held on February 7, 1992. While the details of the agreement remain to be finalized, the following elements are proposed:

- Construction will require the closing of the northbound side of Blossom Street in front of the Hospital. Northbound traffic will be diverted onto the southbound side of the street between the Blackstone Apartments and William Cardinal O'Connell Way. A police detail will be assigned to direct traffic during construction hours. The construction and detour will require the removal of all six parking meters located on the northbound side of the street, and 18 spaces along the southbound side of the street in front of Massachusetts General Hospital. Monetary reimbursement to the City of Boston for lost parking revenues will be paid by Shriners based on the City's formula for estimating revenues.

- Secure fencing, staging and bracing will be provided to protect nearby pedestrian traffic and sidewalk areas available to pedestrians will always be covered. The pedestrian way will cross Blossom Street at William Cardinal O'Connell Way and continue along the William Cardinal O'Connell Way sidewalk to the end of the property line.

- Police officer control will be provided as needed to assure pedestrian safety.

- Construction worker parking will not be permitted on the site or adjacent to the construction area, with the exception of one or two vehicles. Instead, construction workers will be encouraged to utilize the MBTA.

- Movement of construction materials and equipment to and from the job site will be staggered over the course of the workday.

- Clear designated truck routes for the movement of demolition debris and construction materials will be provided.

- The contractor will be required to implement a vehicle reduction program to attain a modal split similar to that of the hospital employees. Efforts will be made to secure parking in close proximity to an MBTA rapid transit station.
- The contractor will distribute MBTA information and provide car pooling information.
- Each construction worker who agrees to commute to the job site via public transportation for a full calendar month will be offered an MBTA pass for that month at a discount.

V. Environmental Protection Component

V. ENVIRONMENTAL PROTECTION COMPONENT

1.0 WIND QUALITATIVE ASSESSMENT

1.1 Introduction

This assessment of pedestrian level winds was performed by Frank H. Durgin, P.E. for the proposed Shriners Burns Institute Replacement Facility in Boston. The study considered pedestrian level winds for existing conditions and the potential effect of the construction of the proposed project on these winds. The assessment is based on:

- A view of existing conditions with building heights for the buildings identified on Figure V-1.1 correlated to a datum at the corner of Blossom Street and Wm. Cardinal O'Connell Way;
- A similar view of build conditions;
- A ground floor plan of the proposed Replacement Facility showing pedestrian and vehicular entrances;
- Photographs of a model of the proposed Replacement Facility showing pedestrian and vehicular entrances;
- Artists drawings of the proposed building's facades;
- A street map, a contour map, and an aerial map of the surrounding area;
- A site map of Massachusetts General Hospital (MGH) giving building names and a site map of the Proposed Replacement Facility and the surrounding area;
- Examination of photographs of a model of the Replacement Facility;
- Three site visits during which photographs were taken of the buildings at the site and surrounding it;

- A site visit when the wind was from the west(w);
- A site visit when the wind was from the WNW;
- A copy of the scoping determination issued by the Boston Redevelopment Authority (BRA);
- An evaluation of the urban context of the proposed project;
- A review of wind climate data for Boston; and
- The author's 22 years of experience in dealing with pedestrian level winds.

Pursuant to the BRA scoping, this evaluation provides a qualitative assessment of pedestrian level winds under existing and build conditions.

1.2 Location and Description of the Project and Surrounding Area

1.2.1 Description of the Project

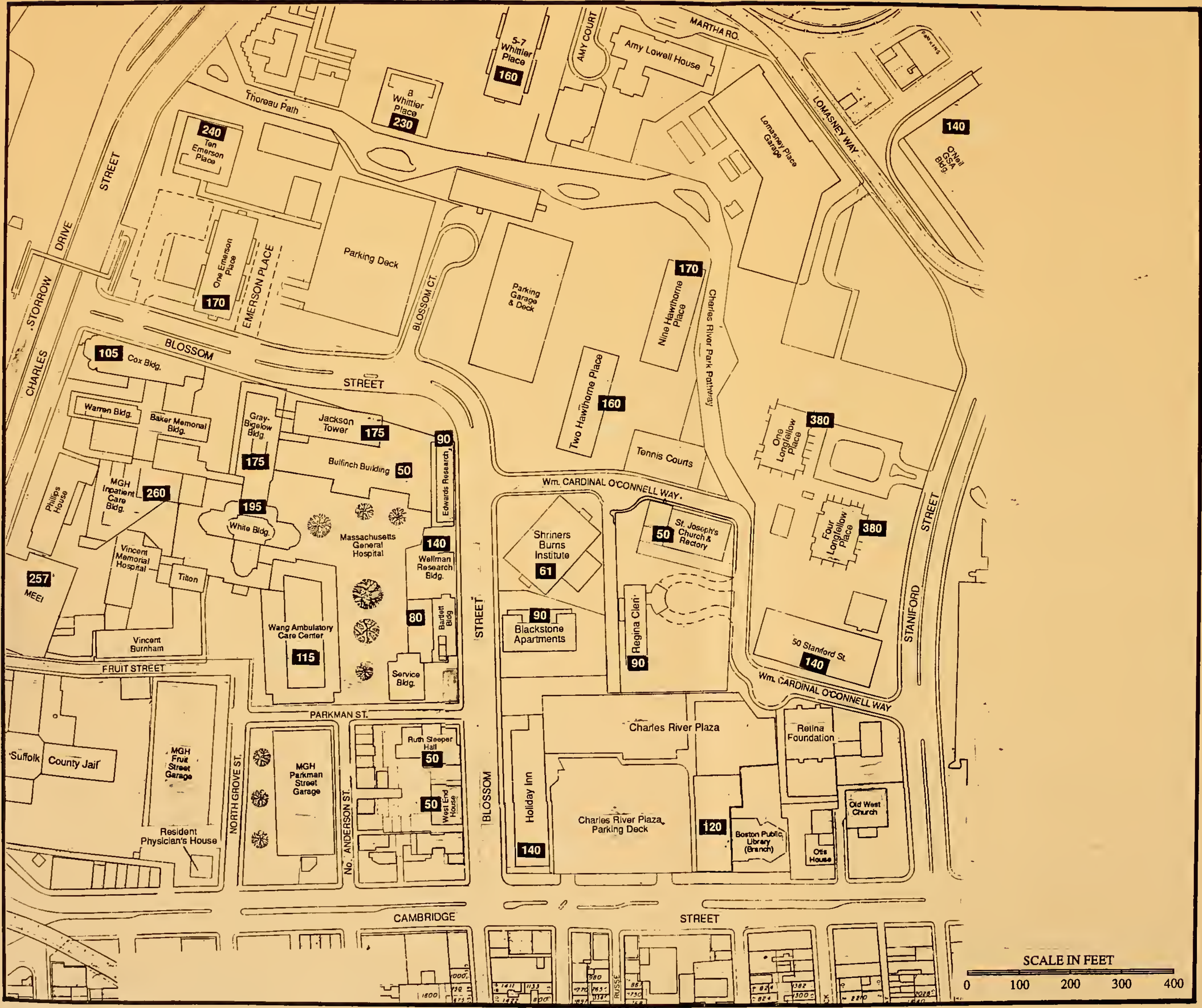
The site of the current and proposed Shriners Burns Institute Replacement Facility is at the southeast corner of the intersection of Blossom Street and the Wm. Cardinal O'Connell Way (Angelo Chester Square). Next to the Burns Institute, Blossom Street runs North-South and Wm. Cardinal O'Connell Way East-West (see Figures V-1.1 and V-1.2).

The existing building occupies about 18,000 square feet of the 40,000± square foot lot, has four stories and is 61 feet high. The Replacement Facility will occupy about 22,000 square feet, has nine stories, and will be 137 feet tall.

1.2.2 The Area Surrounding the Site

The area surrounding the site is a complicated mixture of open spaces and one story garages, and lowrise (2 to 5 stories), midrise (6 to 15 stories), and highrise (16 to 37 stories) buildings up to 380 feet tall. The existing building, at 4 stories and 61 feet, is one of the lowrise buildings. The Replacement Facility at nine stories and 133 feet, will be one of the shorter midrise buildings.

FIGURE V-1.1
PROJECT AREA SHOWING BUILDING HEIGHTS*



LEGEND

240 Building Height

* Heights shown are top elevations above grade and are approximate.

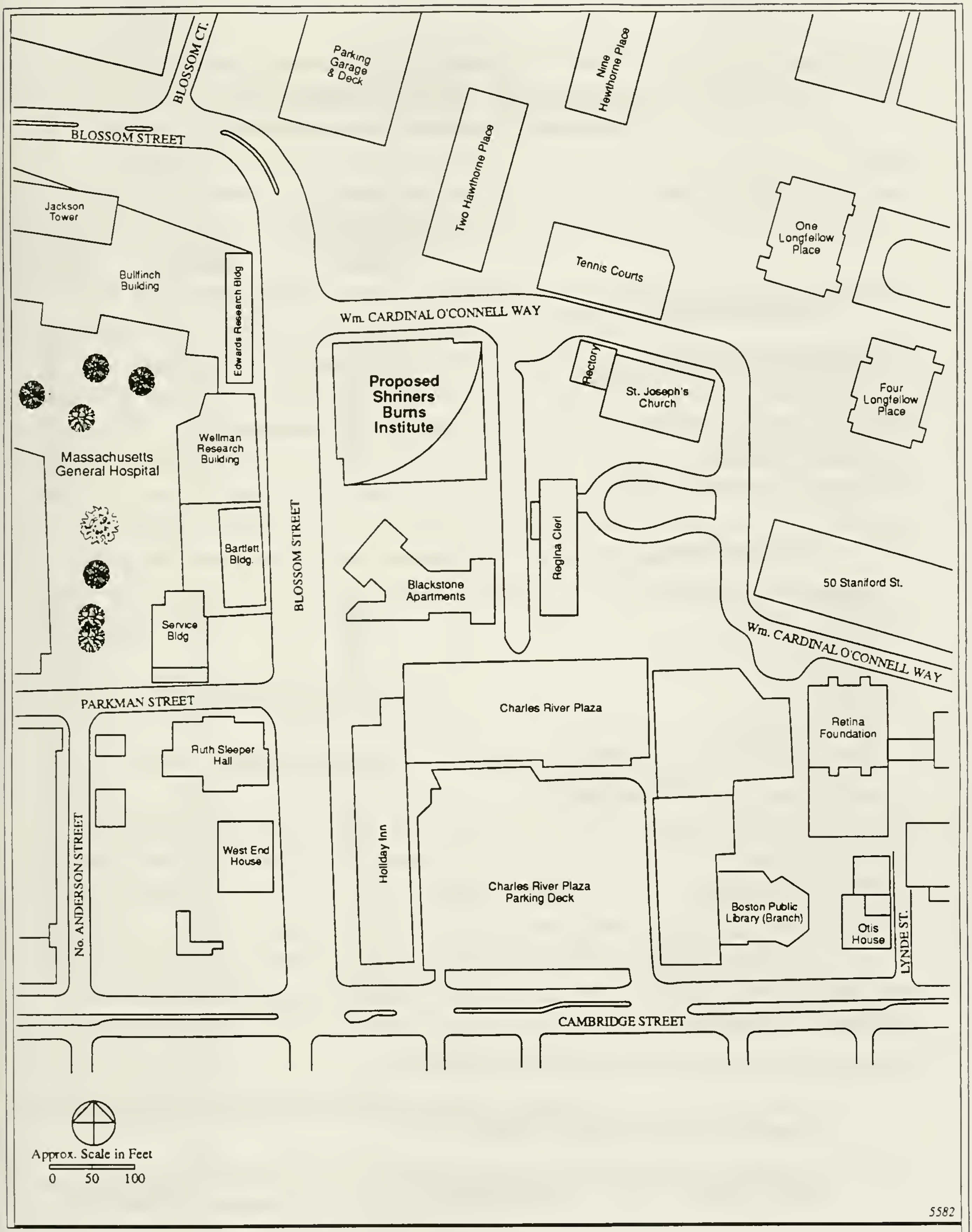


FIGURE V-1.2
SITE MAP
Shriners Burns Institute

TABLE V-1.1

HEIGHTS OF NEARBY BUILDINGS

Shriners Burns Institute Replacement Facility

	Base Elevation Above Sea Level (feet)	Height (stories)	Height (feet)
In the Immediate Vicinity			
Two Hawthorne Place	25	16	160
St. Joseph's Church and Rectory	32	4	50
Regina Cleri	32	7	90
Blackstone Apartments	18	10	90
Bartlett Building	19	8	80
Wellman Research Institute	20	12	140
Edwards Research Building	22	9	90
Buildings Further Away			
Longfellow Place (2 towers)	28	37	380
Bulfinch Building	20	5	50
50 Staniford Street	35	11	140
100 Charles River Park	25	9	120
Holiday Inn	17	14	140
West End House	17	3	50
Ruth Sleeper Hall	16	3	50
Wang Ambulatory Care Center	17	9	115
Old Main MGH (White Building)	16	16	195
New Inpatient Care Building, MGH	16	22	260
Jackson Tower	20	14	175
Grey Bigelow Building	20	14	175
Cox Building	16	8	105
One Emerson Place	23	16	170
Ten Emerson Place	23	23	240
7 and 8 Whittier Place	21	22	230
4, 5 and 6 Whittier Place	21	12	160
1, 2, and 3 Whittier Place	21	16	130
Nine Hawthorne Place	22	16	170
O'Neil GSA Building	17	11	140

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1. Building heights are approximate, including large penthouses, and are from the base up (measured from the base at grade).

2. Base elevation represents the elevation of the base of the building at grade above sea level; add base elevation to building height to get roof elevation above sea level.

The approximate elevation of the base, the number of stories, and approximate height of many of the buildings within two or three blocks of the site are listed in Table V-1.1 and shown in Figure V-1.1.

The existing building's delivery entrance is from a driveway off Wm. Cardinal O'Connell Way between the Burns Institute Facility and St. Josephs Church's Rectory. The delivery entrance will remain at this location with construction of the Replacement Facility.

The Replacement Facility will also include a below grade 150 or more car garage with an entrance off Blossom Street at the SW corner of the building.

The existing Burns Institute Facility has a rectangular footprint with the long wall facing NW toward Angelo Chester Square. The main pedestrian entrance is in the center of that wall. The Replacement Facility has a nearly square footprint with its walls parallel to either Blossom Street or Wm. Cardinal O'Connell Way. It will have two main entrances: one on the west wall; and one on the north wall; both set back about eight feet from the sidewalk under an arcade and about 50 feet from the NW corner of the building. For the upper seven stories, the southeast side of the Replacement Facility will be a quarter circle extending from the southwest corner all the way to the northeast corner of the building as shown in Figure V-1.2.

1.3 The Wind Climate In Boston

1.3.1 Variation of Average Velocity with Height

In general, the natural wind is unsteady (i.e., it is gusty) and its average velocity increases with height above the ground. Figure V-1.3[1] depicts approximately how the average velocity varies with height for different types of terrain. While generally it does not happen, when one puts up any building, the possibility exists, that the building will bring the higher speed winds at the top of the building down to ground level.

Monolithic buildings (i.e., those that do not change shape with height), if they are significantly taller than most of the surrounding buildings, almost invariably will be windy at their base. However, when there are many buildings of similar height in an area, the buildings tend to shelter one another.

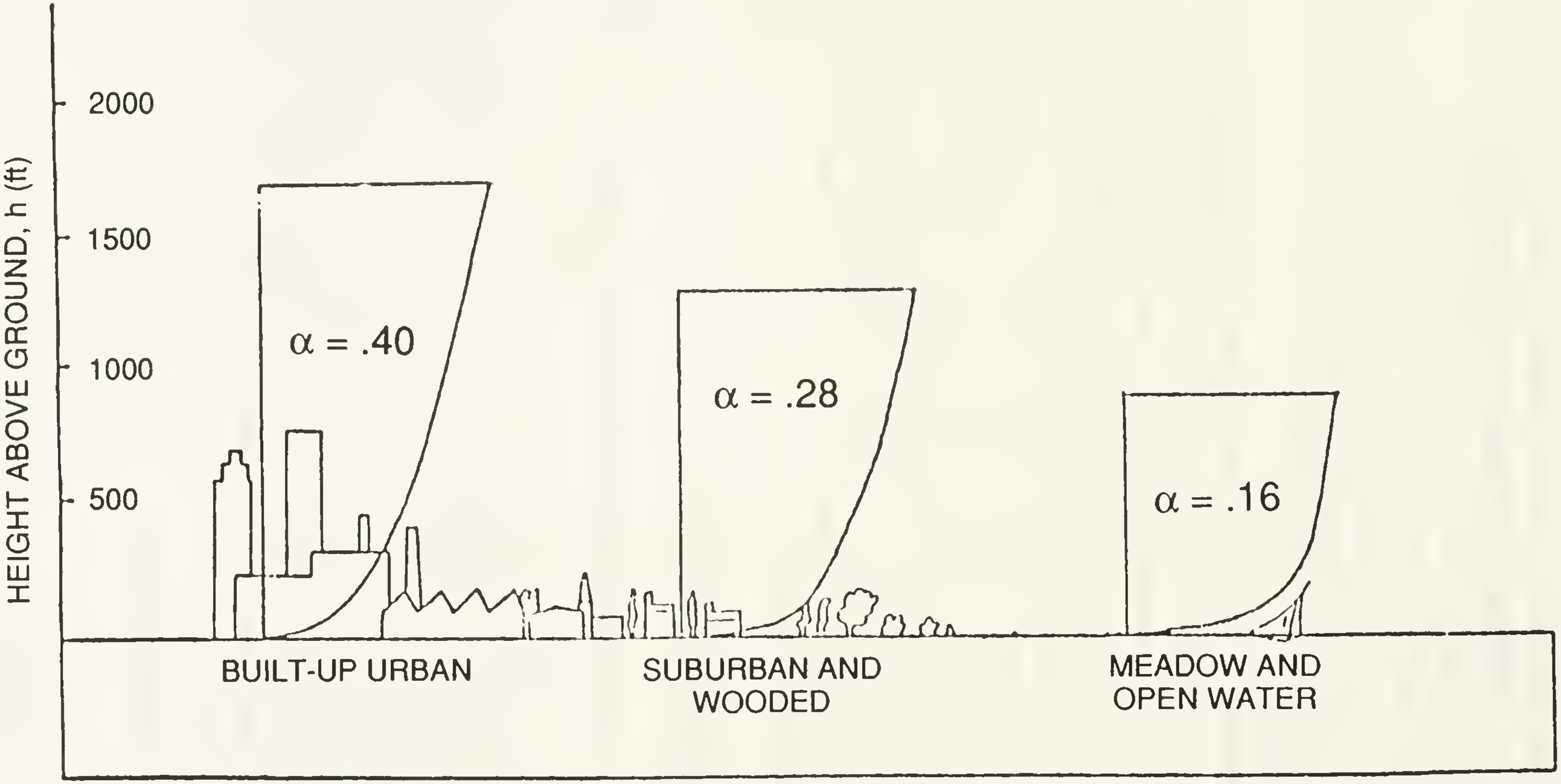


FIGURE V-1.3
TYPES OF EARTH'S BOUNDARY LAYER AFTER DAVENPORT

The existing Burns Institute Facility is lower than most of the surrounding buildings and thus, is probably quite sheltered. The Replacement Facility will be of similar or lower height than many of the surrounding buildings. Thus, it will remain relatively sheltered by those surrounding buildings, but probably not as much so as the existing Burns Institute Facility.

1.3.2 Statistical Description of the Wind

The project site is located about one mile west of Logan Airport. Thus the wind data from Logan Airport that is typically used to define winds for Boston are applicable. Figure V-1.4 depicts a wind rose for Boston. As noted in the figure, the wind rose is based on surface wind data from Logan Airport taken from 1945 to 1965. The length of each line radiating from the center of the figure to the outer most crossing line is proportional to the total time the wind comes from that direction. The other lines crossing the radial lines indicate the frequency of winds less than 7.5, 12 and 19 mph.

Figure V-1.4 shows that the winds in Boston come primarily from the Northwest, west, and southwest. Figures V-1.5 to V-1.8 show wind roses for Boston for Winter (Dec., Jan., and Feb.), Spring (Mar., Apr., and May), Summer (Jun., Jul., and Aug.), and Fall (Sep., Oct., and Nov.). These figures show that northwest winds tend to occur during the colder months and southwest winds during the warmer months. Spring and Fall are transitional, but winds are stronger in the Spring than in the Fall. Strong easterly winds usually occur during storms when there is precipitation. Northwest winds blow directly at the NW face of the existing Burns Institute (Figure V-1.1). Southwest winds blow diagonally across Blossom Street at the Burns Institute's southwest facade (Figure V-1.1). The effect of these winds as well as easterly storm winds is discussed below separately.

The average wind speed at Logan Airport at 58 feet (the average height at which the data was taken) is 12.9 mph. At pedestrian level (i.e., chest height, 4.5 feet), it is about 8 mph. The average wind speed at 58 feet at Logan Airport for each month is shown in Figure V-1.9. Seasonally, the average is 14.2 mph in the winter, 13.9 mph in the spring, 11.2 mph in the summer, and 12.3 mph in the fall. The fastest hourly wind for a 100 hour return period is slightly faster, however, in the Spring than in Winter.

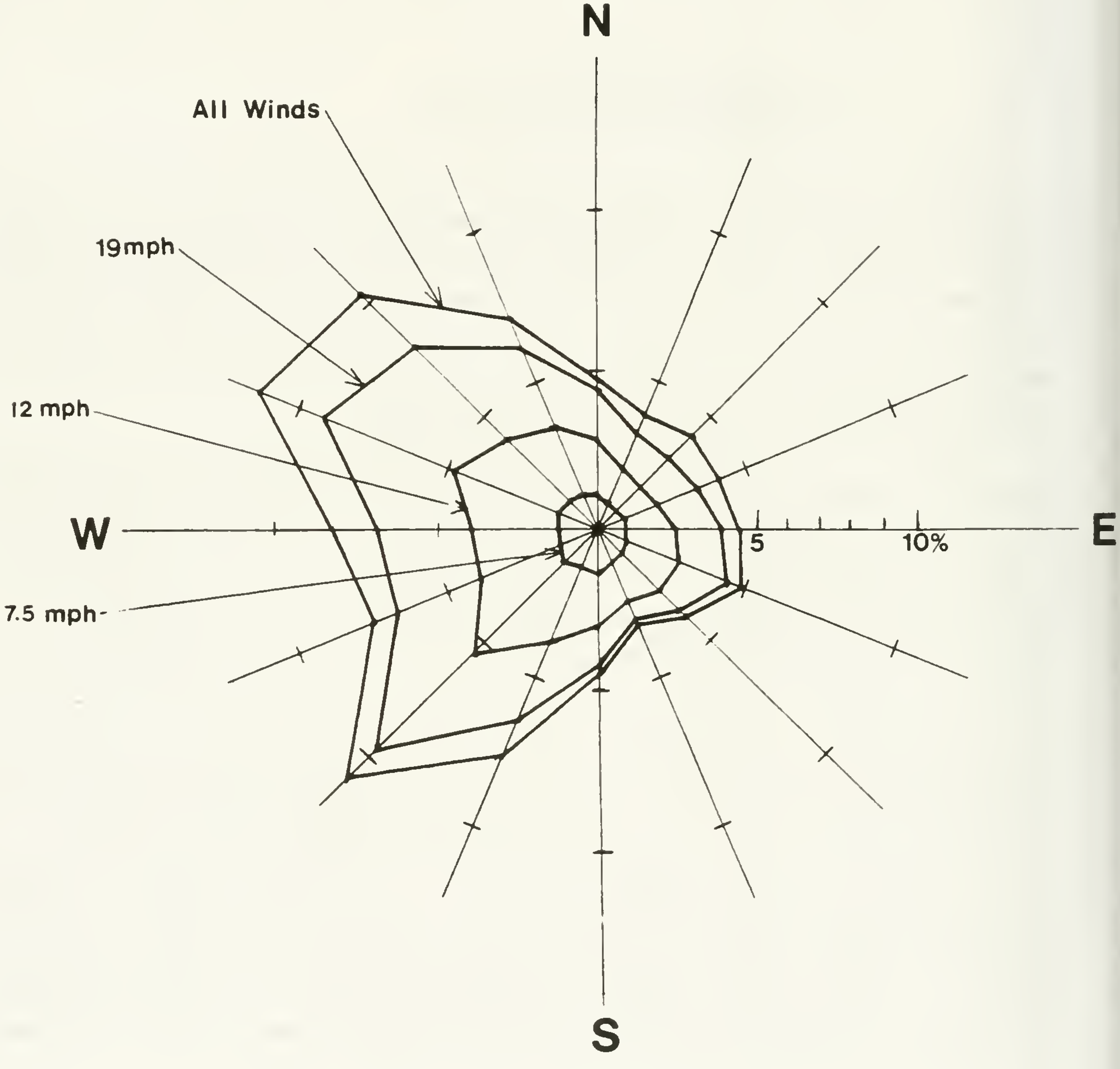


FIGURE V-1.4
BOSTON WIND ROSE FOR THE YEAR
(Surface data obtained from Logan International Airport 1945-1965)

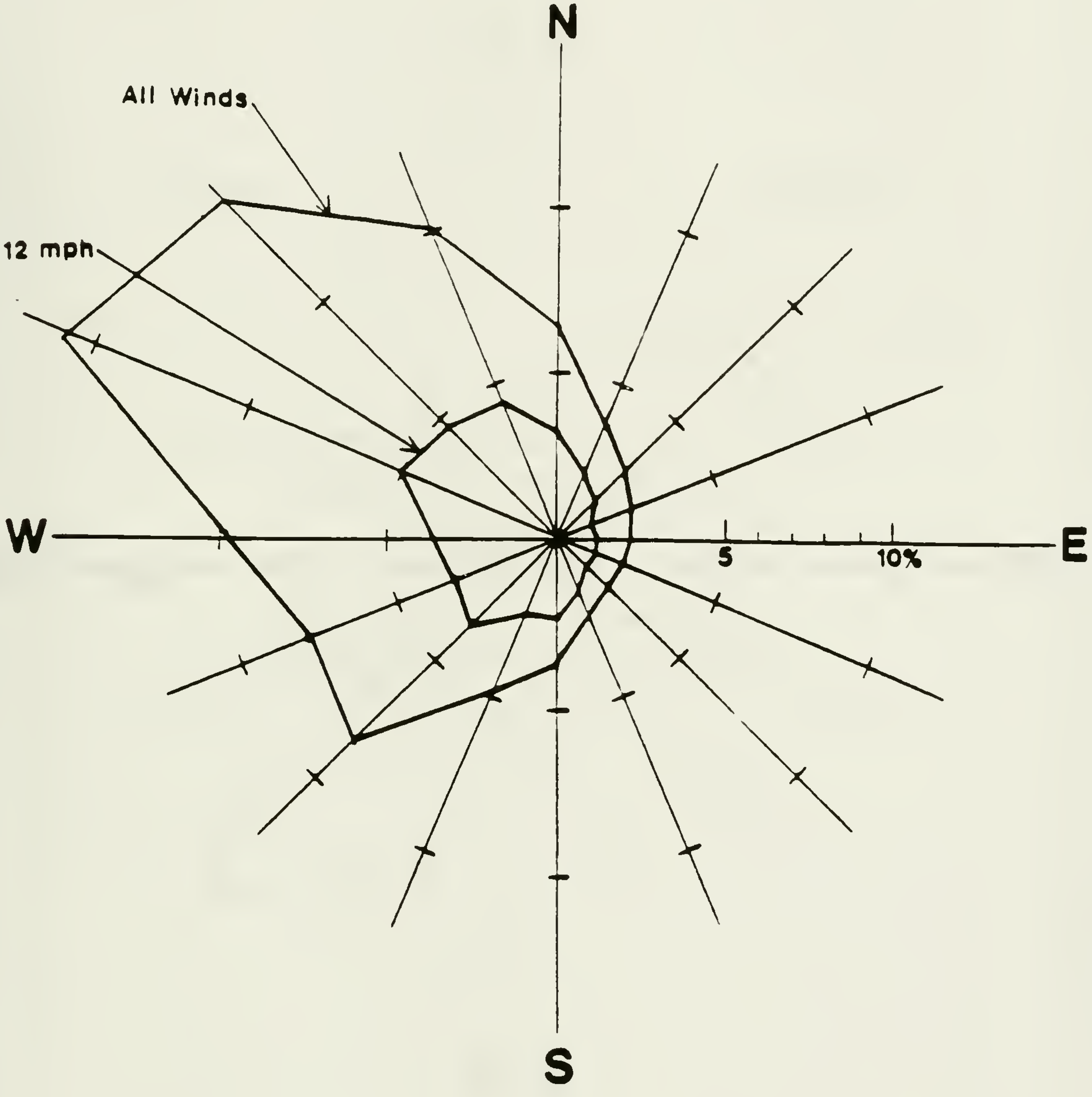


FIGURE V-1.5
BOSTON WIND ROSE FOR THE WINTER
(DECEMBER, JANUARY, FEBRUARY)
(Surface data obtained from Logan International Airport 1945-1965)

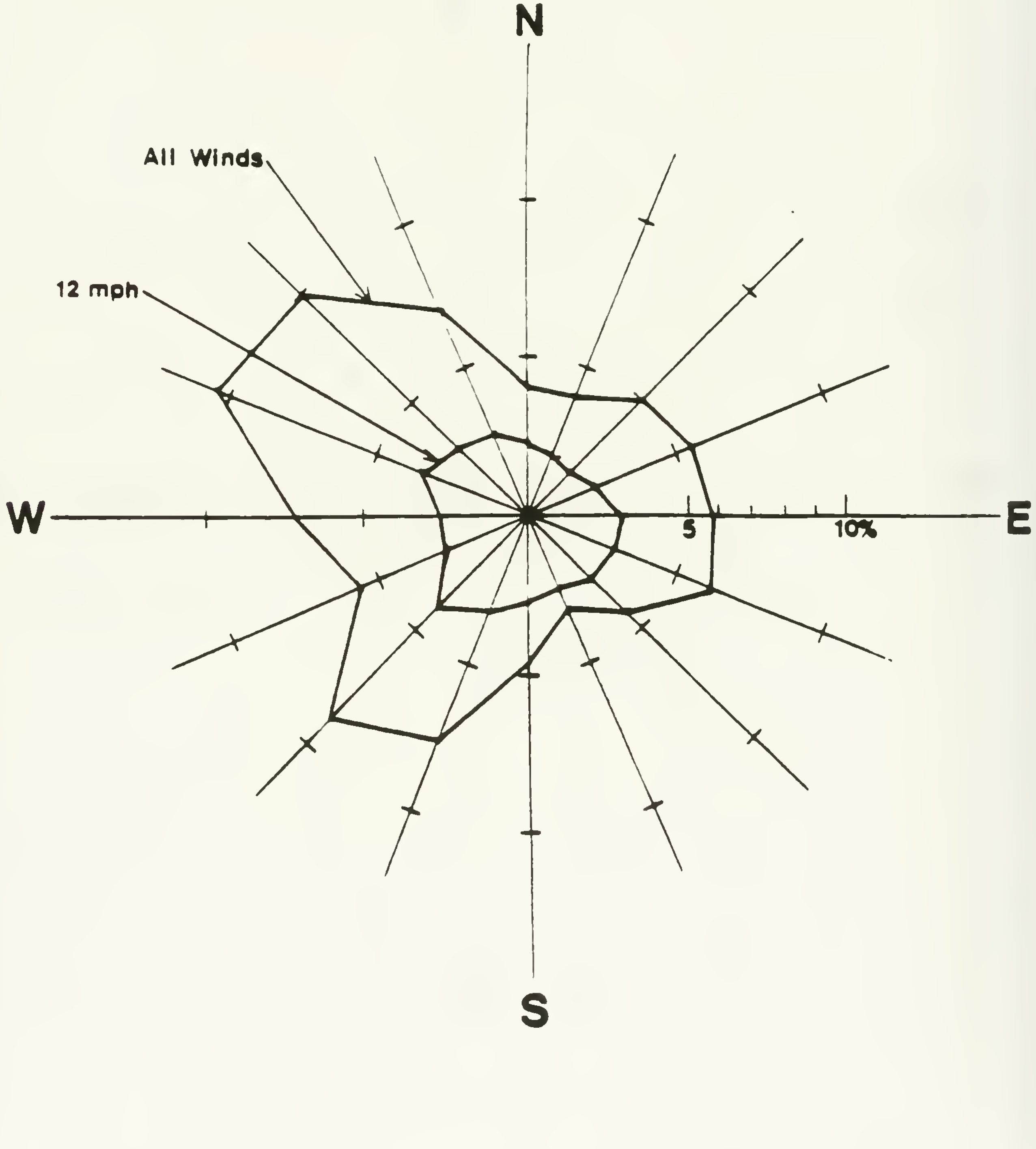


FIGURE V-1.6
BOSTON WIND ROSE FOR THE SPRING
(MARCH, APRIL, MAY)
(Surface data obtained from Logan International Airport 1945-1965)

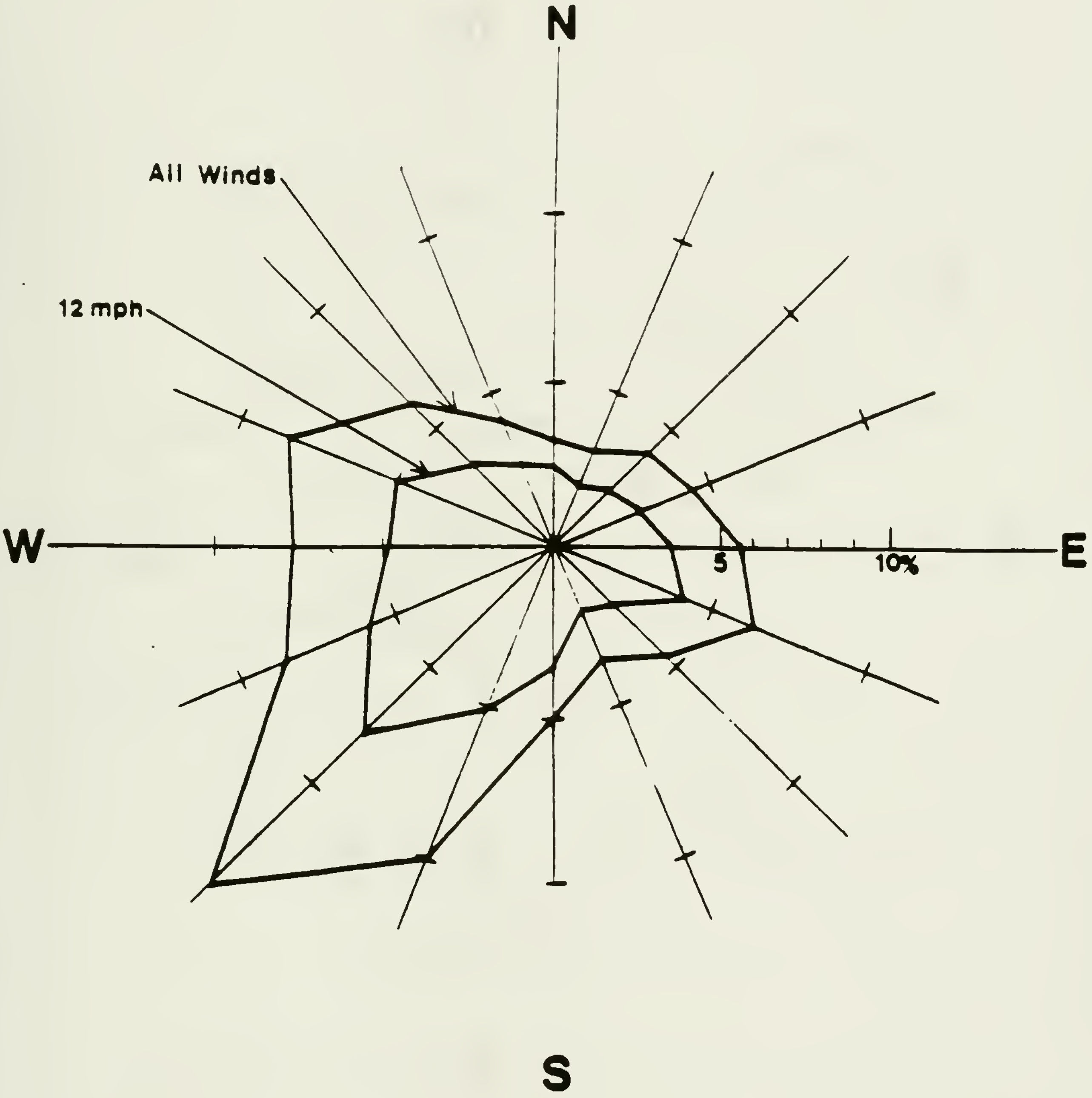


FIGURE V-1.7
BOSTON WIND ROSE FOR THE SUMMER
(JUNE, JULY, AUGUST)
(Surface data obtained from Logan International Airport 1945-1965)

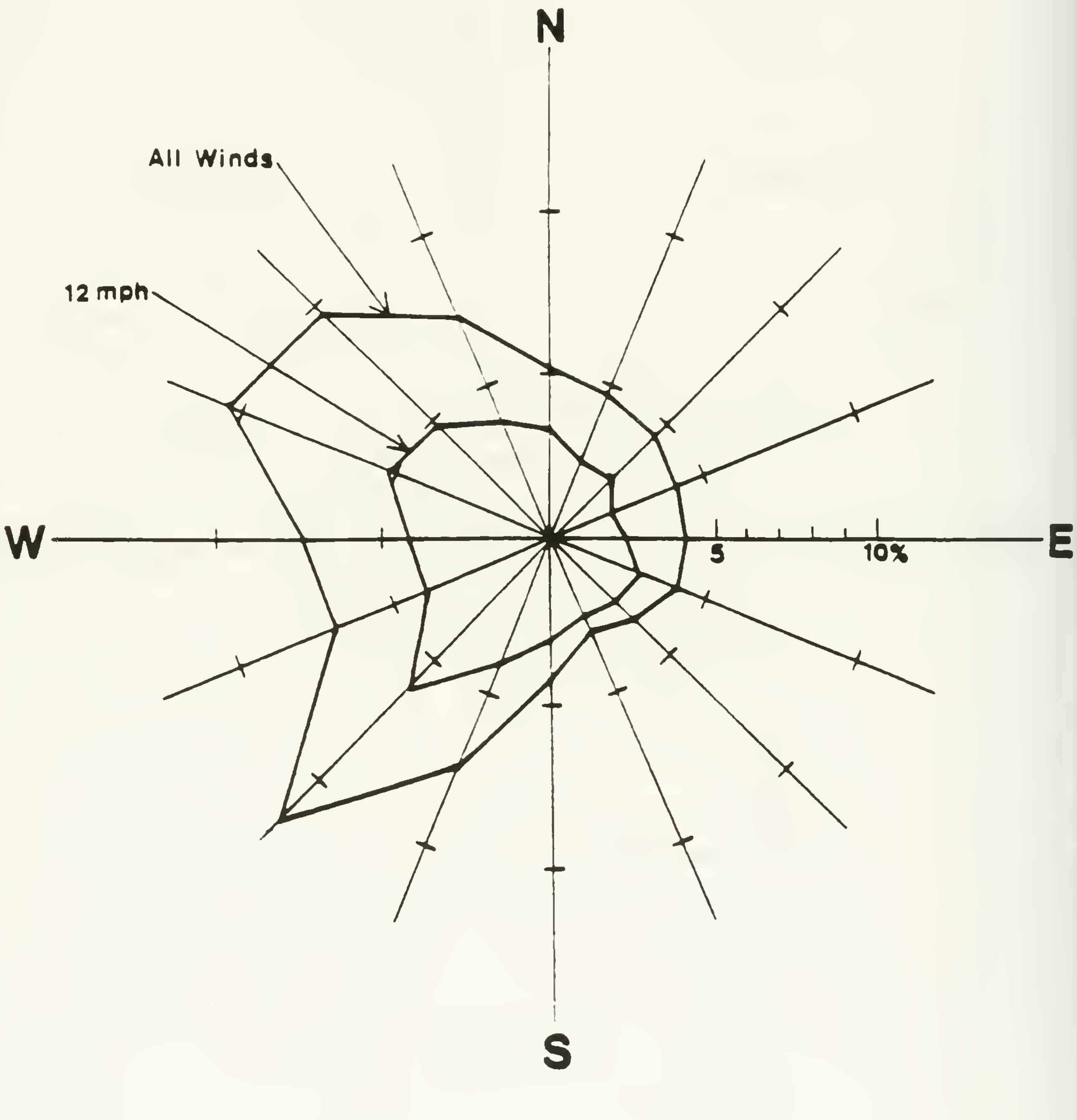


FIGURE V-1.8
BOSTON WIND ROSE FOR THE FALL
(SEPTEMBER, OCTOBER, NOVEMBER)
(Surface data obtained from Logan International Airport 1945-1965)

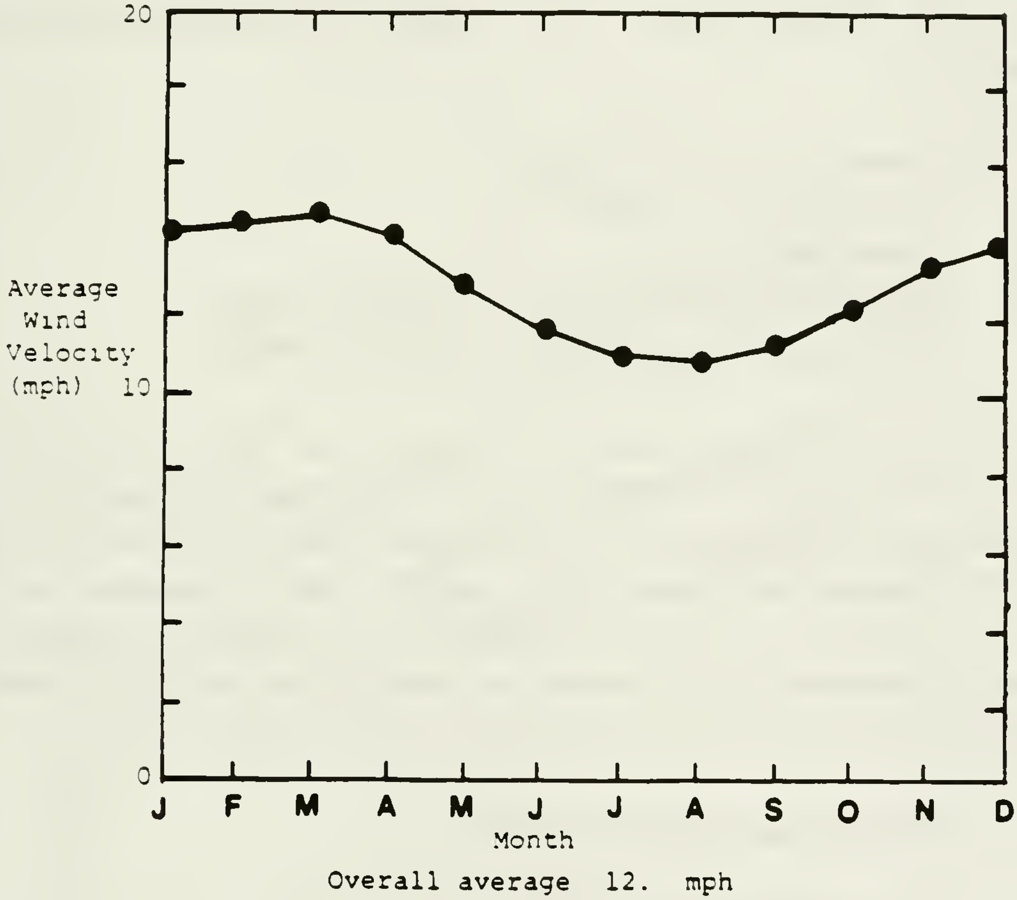


FIGURE V-1.9
AVERAGE WIND VELOCITY AT LOGAN AIRPORT AT 58 FT.
1945-1965 BY MONTH

1.4 Criteria for Pedestrian Level Winds

Since the early 1980s, Boston has used a guideline criteria for acceptable winds of not exceeding a 31 mph effective gust more often than once in 100 hours. The effective gust is defined as the average plus 1.5 times the root mean square variation (rms) above the average.

In 1978, Melbourne[2] developed a probablistic criteria for average pedestrian level wind speeds which accounted for different type of pedestrian activity as well as the safety aspects of such winds (see Figure V-1.10). He defined five categories of pedestrian level wind speeds:

1) Dangerous and Unacceptable.
2) Uncomfortable for Walking.
3) Comfortable for Walking.
4) Comfortable for Short Periods of Standing or Sitting.
5) Comfortable for Long Periods of Standing or Sitting.

These criteria are not absolute (any location can have dangerous winds in a hurricane), rather, they imply that the location would have wind speeds such that the activity suggested is possible most of the time, and would be perceived as such by most people who frequent the location. For example, winds at pedestrian level at Logan Airport are just in the Category 2 (uncomfortable for walking) (see Figure V-1.10), and just under the guideline 31 mph effective gust wind speed, so most people would perceive conditions in the open at the airport as uncomfortable for walking.

1.5 Pedestrian Level Winds at the Site

1.5.1 Introduction

In the following sections, the effects of the northwest winter winds, the southwest summer winds and easterly storm winds will be discussed for the Existing and Build conditions as shown in Figures V-1.11 and V-1.12.

The weather in New England is influenced by large coastal storms (fall, winter, and spring) and the Bermuda High (summer). Typically, when a coastal storm occurs, it rains or snows for four to twelve hours, then it clears, and, as the storm moves off to the NE, the wind blows from the northwest for three or four days until the next storm system arrives.

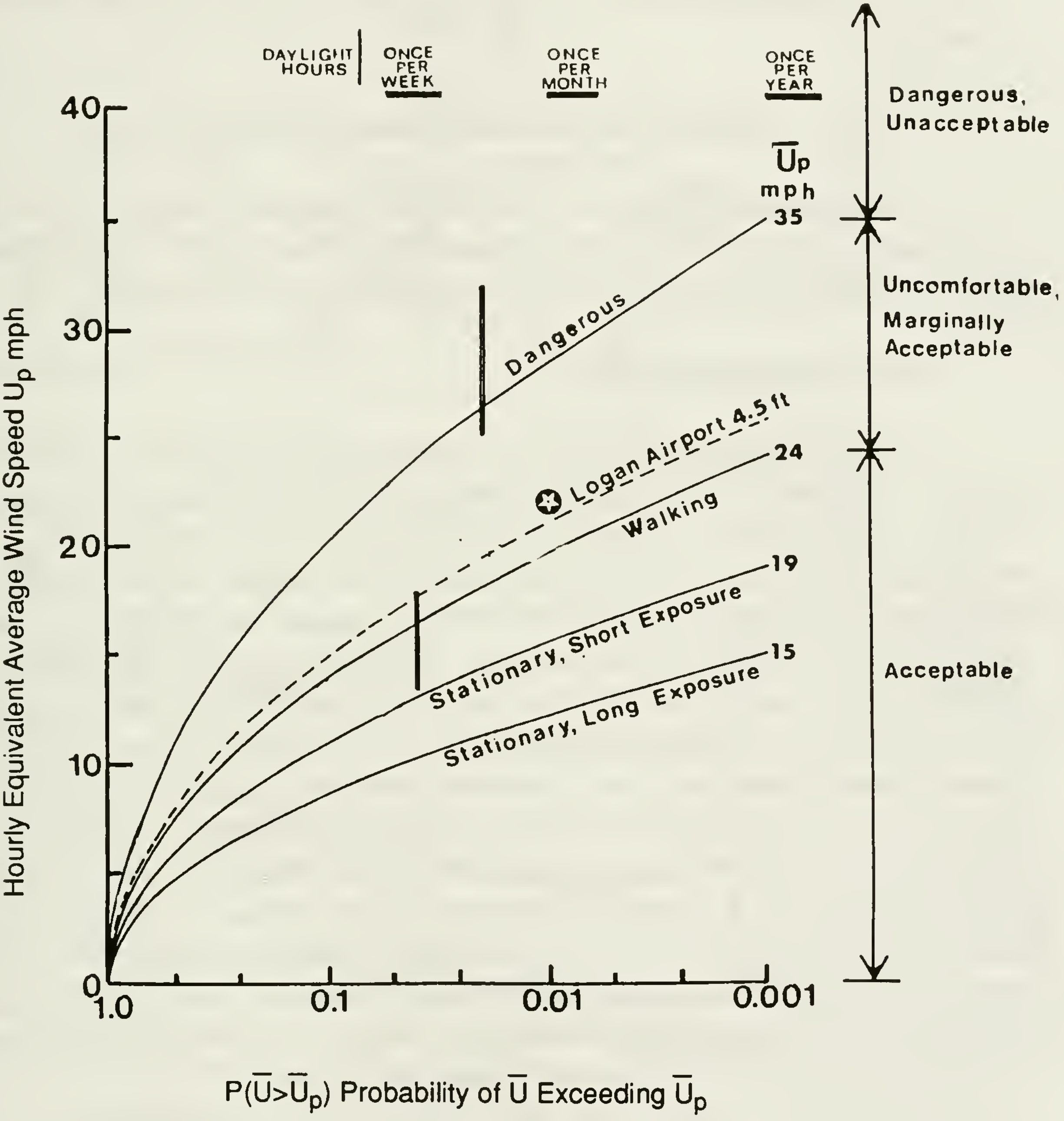


FIGURE V-1.10
PEDESTRIAN LEVEL WINDS
COMFORT CRITERIA LEVELS

These storms, and the northwest winds following them, occur mostly in the fall, winter, and spring. Northwest winds are particularly uncomfortable in the winter, when typically they occur on cold days and for this site, when most of the trees will be leafless (and less shielding). The Bermuda high is responsible for the southwest winds that occur in the summer.

1.5.2 Northwest (Winter) Winds (Figures V-1.11 and V-1.12)

As previously noted, northwest winds blow diagonally across Angelo Chester Square and directly at the main entrance of the existing Burns Facility, which is in the middle of the northwest facade. Such winds can be uncomfortable on a cold winter day.

Existing Conditions (Figure V-1.11)

As northwest winds approach the site and immediate surrounding area, they must pass by and around One and Ten Emerson Place (16- and 23-story buildings, respectively) and the two Whittier Place Buildings (16- and 22-story buildings). However, once by these buildings, there is about 700 feet of open space before reaching Angelo Chester Square and the Burns Institute site. Thus, while one would expect these winds to be reduced by the Emerson and Whittier Place Buildings, this long open area may result in some recovery of wind speeds. Also, the more westerly of these NW winds must come around the Jackson Tower and Edwards Building, the turn in Blossom Street just to the north of Angelo Chester Square. As a result, the main entrance to Two Hawthorne Place and the SE corner of that building are quite windy (Category 3 and high 3, respectively). Also, because the main entrance to the existing Shriners Burns Center is in the center of the NW wall of the building, it is probably not particularly windy (Category 4). However, the areas near the north and west corners at the existing Burns Facility and in the small vegetated setback between the main entrance and the corner of Blossom Street and Wm. Cardinal O'Connell Way are generally quite windy (high Category 3 at the corners and Category 3 in the park in the winter when there are no leaves on the trees).

This NW wind is split by the Burns Center, with some wind blowing up Wm. Cardinal O'Connell Way and some blowing south down Blossom Street. Along Blossom Street there is some windiness along the west sidewalk and at the entrances to the MGH research centers (Category 4) off that sidewalk (low to middle category 3). The east side

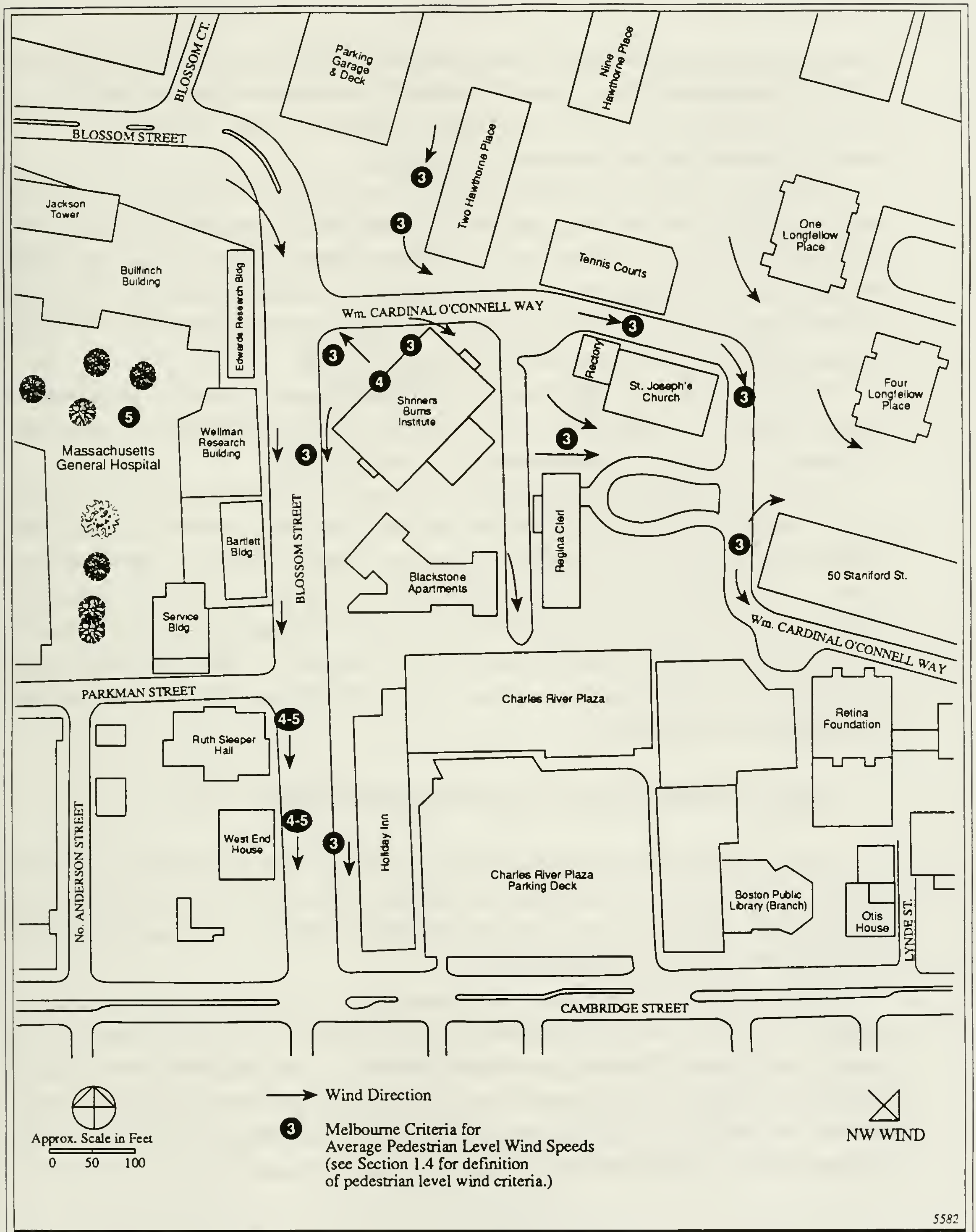


FIGURE V-1.11
NORTHWEST WINDS EXISTING CONDITIONS
Shriners Burns Institute

of Blossom Street is windier, but the only entrances on that side are: (1) to the Blackstone Building (Apartments), which is set well back from the street and therefore not effected, and (2) to the Holiday Inn. The latter may be somewhat windy, but that windiness is caused primarily by the Holiday Inn itself (Category 3).

The main courtyard of MGH, between the Edwards, Wellman, and Bartlett Research Buildings and the Wang Ambulatory Care Center, is completely sheltered from NW winds by the Jackson Tower, the Grey-Bigelow Building and the many larger MGH Buildings to the west and northwest. Winds there are in Category 5. Also, the winds near the Ruth Sleeper Hall and the West End House are quite modest (Category 4 or 5) due to the sheltering effect of the other MGH Buildings.

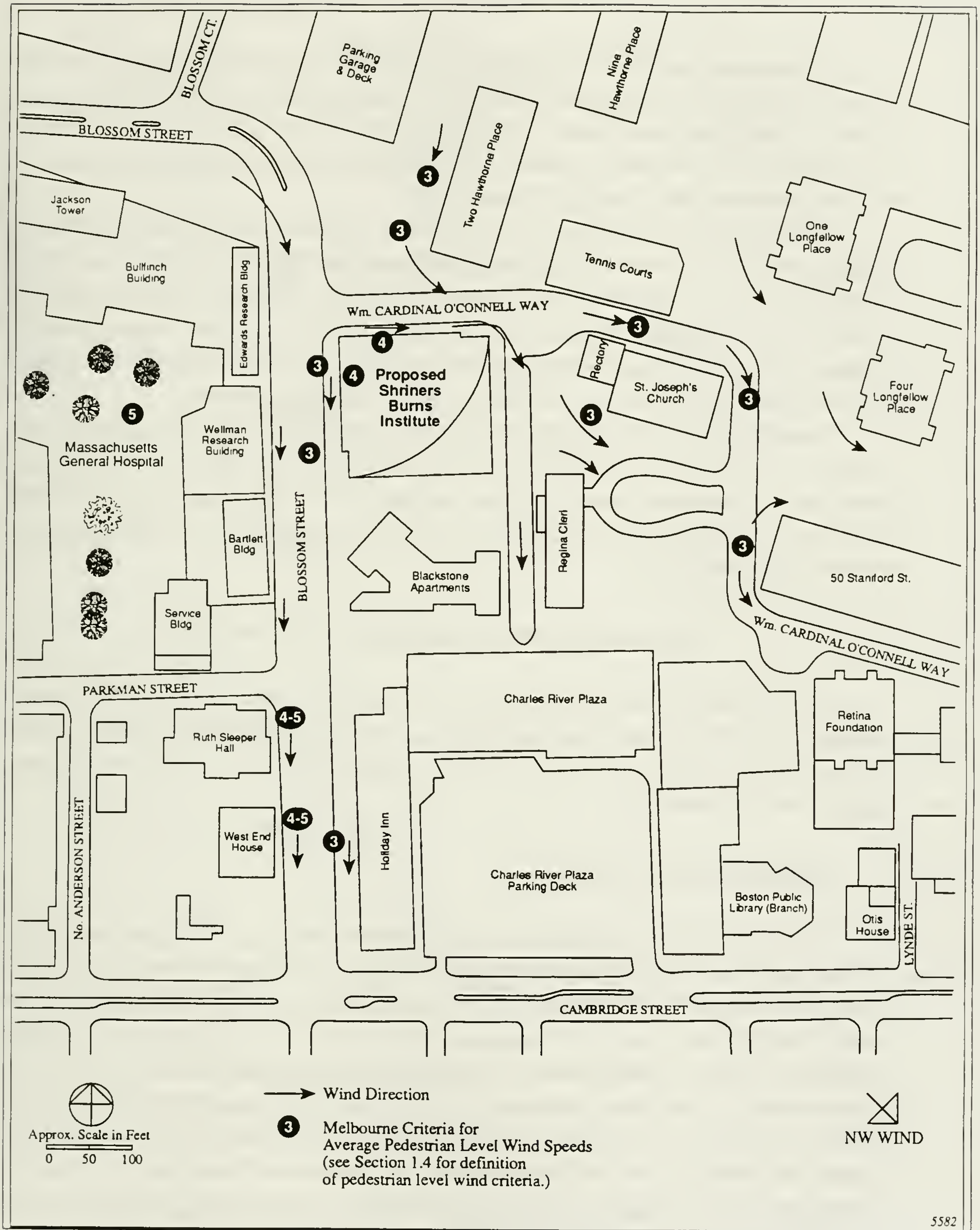
The wind blowing up Wm. Cardinal O'Connell Way splits again to go around St. Joseph's Rectory. This appears to add to the winds in the path between the Rectory and the Regina Cleri created by The Regina Cleri (Low Category 3).

Currently, in the winter when there are no leaves on the trees, it is likely very windy (perhaps as high as Category 2) in the path that runs from Wm. Cardinal O'Connell Way to Nine Hawthorne Place where winds pass between Longfellow Place and the tennis court to the east of Two Hawthorne Place. The windiness, somewhat reduced, extends all the way to the main entrance of St. Joseph's Church as well as along Wm. Cardinal O'Connell Way in front of the Regina Cleri (perhaps to a high Category 3). This windiness is due to the presence of the two Longfellow Place Towers, the Two and Nine Hawthorne Place buildings and 50 Staniford Street.

Impact of Replacement Facility on Northwest Winds (Figure V-1.12)

For NW winds, the Replacement Facility will have little or no effect on the NW winds in the MGH Courtyard, or near Ruth Sleeper Hall and the West End House. Nor will it have any effect at the main entrance to St. Joseph's Church and along Wm. Cardinal O'Connell Way in front of the Regina Cleri.

While the Replacement Facility will be about twice as high as the existing building, it will still be lower than the Jackson Tower, the Grey-Bigelow Building, and about the same height as the Edwards, Wellman, and Bartlett Buildings. The NW wind approaching the Replacement Facility will still come over the 700 foot long open space between the Emerson and Whittier Place Buildings and the Replacement Facility. Thus, the winds at the main entrance to Two Hawthorne Place will remain unchanged.



3 Melbourne Criteria for Average Pedestrian Level Wind Speeds (see Section 1.4 for definition of pedestrian level wind criteria.)

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FIGURE V-1.12

NORTHWEST WINDS PROPOSED CONDITION

Shriners Burns Institute

The increased height of the Replacement Facility and the juxtaposition of its NW corner and SE corner of Angelo Chester Square will probably cause the Replacement Facility to bring high speed winds to the ground along its walls on Blossom Street and Wm. Cardinal O'Connell Way, although those along Blossom Street can be expected to be less than those along Wm. Cardinal O'Connell Way.

This means that the entrances to the Edwards, Wellman, and Bartlett Buildings on Blossom Street will be somewhat, but not significantly windier than they are now (low in Category 3). The entrance to the Replacement Facility on Blossom Street would be windier than the existing entrance (high Category 3) if it were not set back into the building by five to six feet as is presently planned. With the planned setback, the winds at both entrances will probably be in Category 4 or low Category 3 at worst.

The added size and height of the Replacement Facility will make it higher than the Regina Cleri causing it to almost completely shield the Regina Cleri from NW winds. Therefore, for northwest winds, existing windiness in the path between St. Joseph's Rectory and the Regina Cleri is expected to see some improvement with construction of the project (to Category 4).

1.5.3 Southwest (Summer) Winds (Figures V-1.13 and V-1.14)

The prevailing winds in the summer are from the southwest. Southwest winds approach the site diagonally across Blossom Street from Cambridge Street to Wm. Cardinal O'Connell Way. It should be born in mind that, on hot summer days, some windiness may be desirable.

Existing Conditions (Figure V-1.13)

For SW winds, West End House and Ruth Sleeper Hall are shielded by Beacon Hill and the many three and four story buildings on it. Thus, winds around these locations are probably in Category 5. The Holiday Inn, at 140 feet high, is not as shielded because of its height. Even so the winds at its entrance are no worse than Category 4. The Main Courtyard of MGH is shielded from SW winds by all of the existing buildings of MGH, the closest of which is the Wang Ambulatory Care Center. The presence of the four-story Bulfinch Building in front of the Jackson Building and Grey-Bigelow Building probably prevents the classic vortex that forms in front of the Jackson Tower and Grey-Bigelow Building for the more southerly of these SW winds from ever reaching the ground. Thus, for SW winds Courtyard conditions are near calm (Category 5).

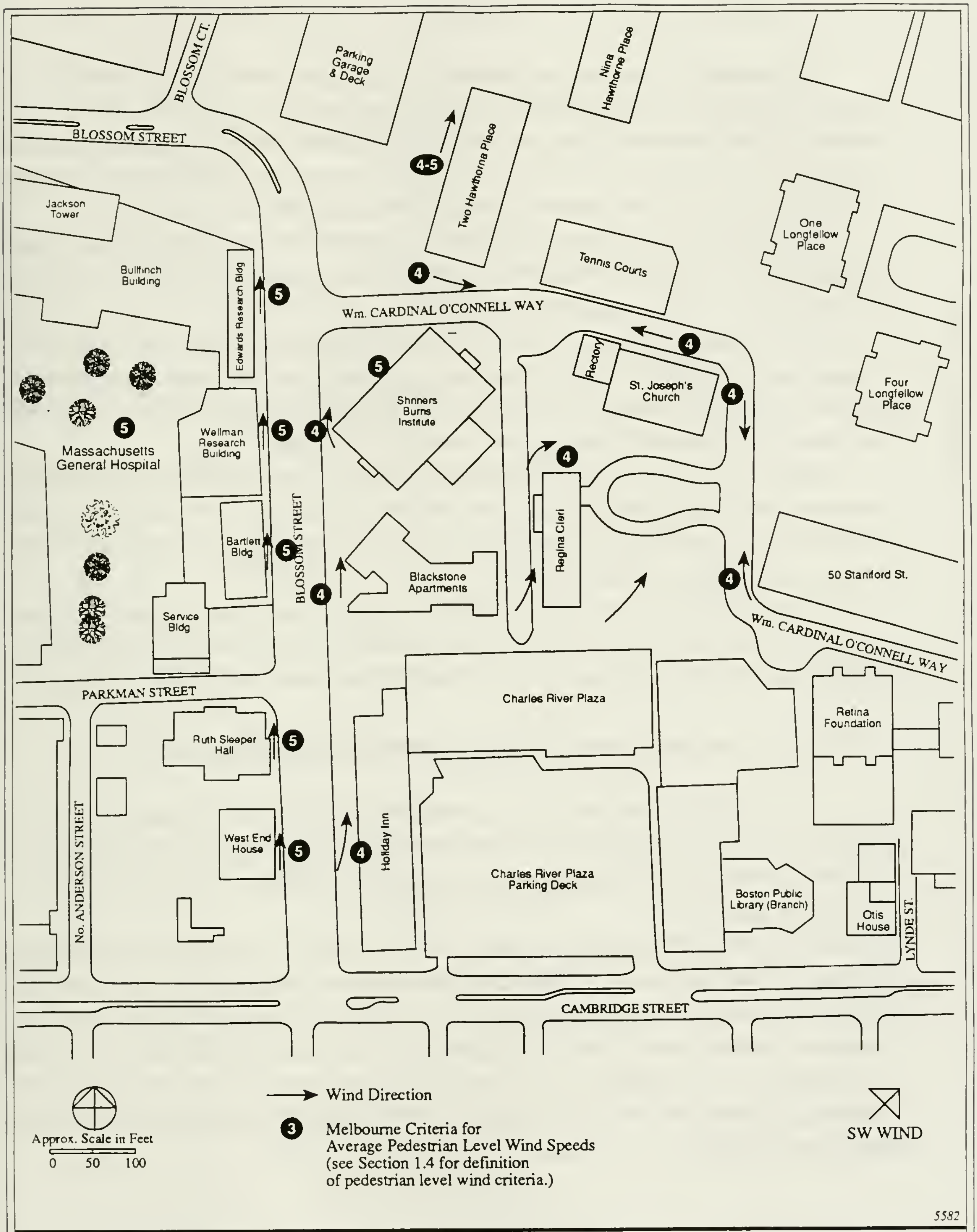

FIGURE V-1.13
SOUTHWEST WINDS EXISTING CONDITIONS
Shriners Burns Institute

The entrances to the Bartlett, Wellman, and Edwards Buildings off Blossom Street are all in the lee of those buildings and thus very sheltered from SW winds. There probably is some windiness along the east side of Blossom Street, but it is very modest (Category 4 at most) and as already noted, the entrance to the Blackstone Building (Apartments) is set far back from the street and thus, it not affected by these winds.

The Bartlett and Wellman Buildings are upwind of the existing Burns Center Building and act to shield it from SW winds. Thus winds at and near the main entrance to the existing Burns Center are light (Category 5).

Two Hawthorne Place is also in the lee of the Wellman and Edwards Buildings, but is taller than both, and so tends to deflect some wind down to street level. Thus, its entrance is probably somewhat windier, and its south wall probably deflects some wind east along Wm. Cardinal O'Connell Way (Category 4 at most).

Both the Holiday Inn and the Blackstone Building (Apartments) tend to provide upstream shielding for the Regina Cleri Building. Even so, there probably is some windiness at the north end of the Regina Cleri Building between it and St. Joseph's Rectory (no worse than Category 4).

Currently, for SW winds, there is some windiness along Wm. Cardinal O'Connell Way in front of both St. Joseph's Church and the Regina Cleri Building (Category 4). The primary causes of this windiness are the two Longfellow Towers and 50 Staniford Street.

Impact of the Replacement Facility on Southwest Winds (Figure V-1.14)

For SW winds, West End House, Ruth Sleeper Hall, the Holiday Inn, and the Bartlett Building are all upwind of the proposed Shriners Replacement Facility and thus the winds there will not be affected by the Replacement Facility. This is also true for the Main MGH Courtyard.

The Replacement Facility is about the same height as the Bartlett and Wellman Buildings, which will make its effect on the winds in Blossom Street minimal. The sidewalk outside main entrance to the Replacement Facility on Blossom Street will experience some of the windiness, but because the entrance it is recessed in the arcade, the winds there will be relatively light (Category 5). The winds at the entrance on Wm. Cardinal O'Connell Way will be in Category 5, since that entrance will be in the lee of the Replacement Facility.

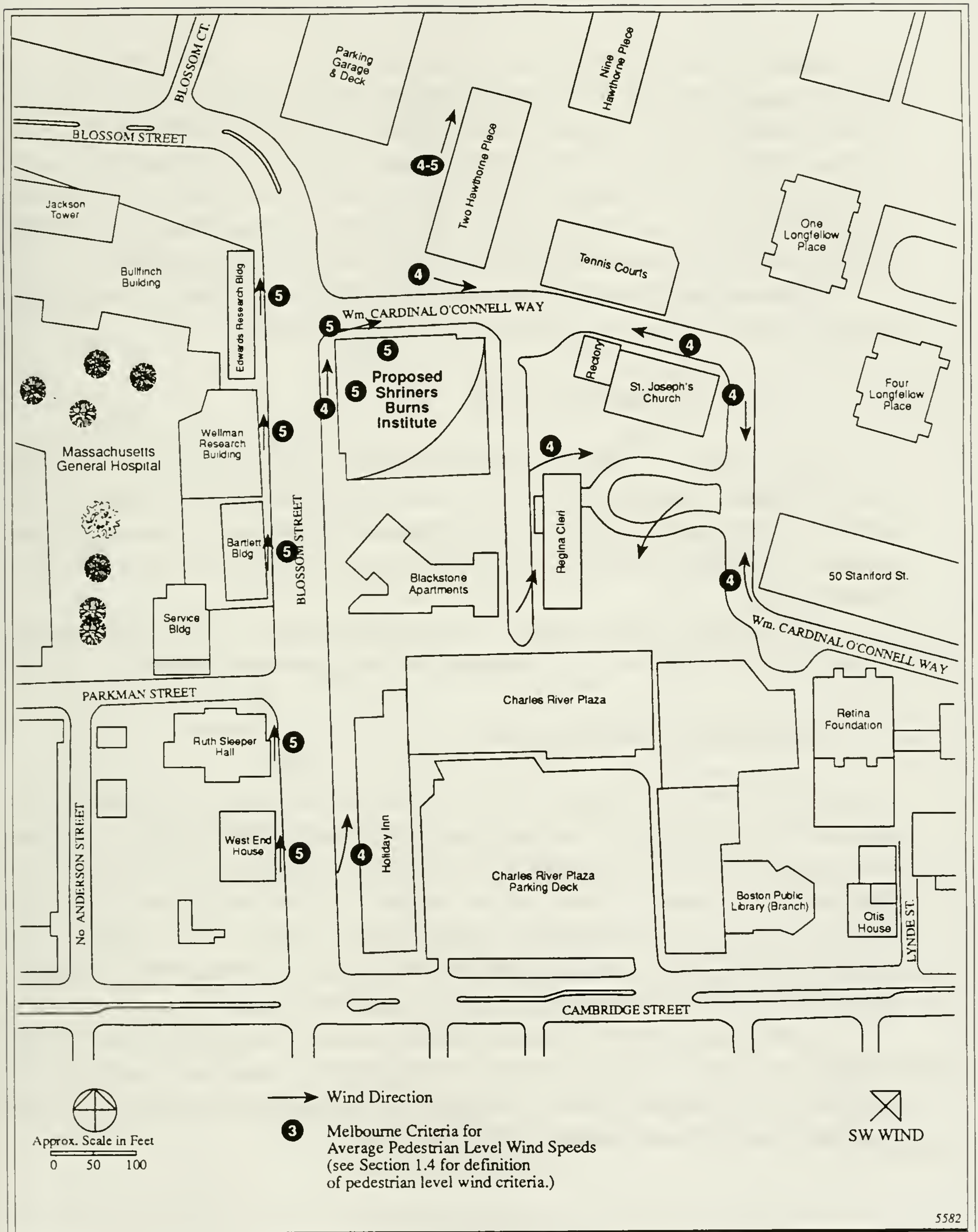

FIGURE V-1.14
SOUTHWEST WINDS PROPOSED CONDITION
Shriners Burns Institute

Because the Replacement Facility is taller than the existing building, it will provide shielding against SW winds for the One Hawthorne Place Building, and thus reduce any current windiness in Wm. Cardinal O'Connell Way to the east of that building. However, for these winds, the project will cause some increase in the winds on the path between St. Joseph's Rectory and the Regina Cleri Building (no worse than Category 4). There are a number of deciduous trees near this path that currently provide considerable shielding from SW winds in the summer and will continue to do so when the project is built.

The Replacement Facility will have little or no effect on the winds in Wm. Cardinal O'Connell Way in front of St. Joseph's Church and the Regina Cleri.

1.5.4 Easterly (Storm) Winds

Easterly winds occur about one third of the time. Light easterly winds occur as a storm first starts or in the summer as a sea breeze. During the first 4-12 hours of a typical storm, it rains or snows depending on the temperature, and the wind is generally from the northeast or southeast depending on whether the center of the storm passes to the east or west of the city.

Since, for strong easterly winds, it will generally be snowing or raining, the emphasis in the following discussions will be on entering or exiting the various buildings.

Existing Conditions (Figure V-1.15)

For NNE, NE and E winds (the most common of the easterly winds), the site and most of its surroundings are in the lee of the two Hawthorne Place Buildings, the O'Neil GSA Building, and the two Longfellow Place Towers. It seems unlikely that currently the area around St. Joseph's Church and the Regina Cleri Building are windy for these conditions. In the area along Wm. Cardinal O'Connell Way near the entrance of St. Joseph's Church, windier conditions are possible, caused by winds emanating from the bases of the Longfellow Towers (high Category 3, if such winds occur).

For the more northerly of these winds it seems likely that the main entrance to the existing Burns Center may be somewhat windy (possibly as windy as Category 3). The entrances to the Edwards, Wellman, and Bartlett Buildings may also be quite windy for these more northerly winds (again, no worse than Category 3).

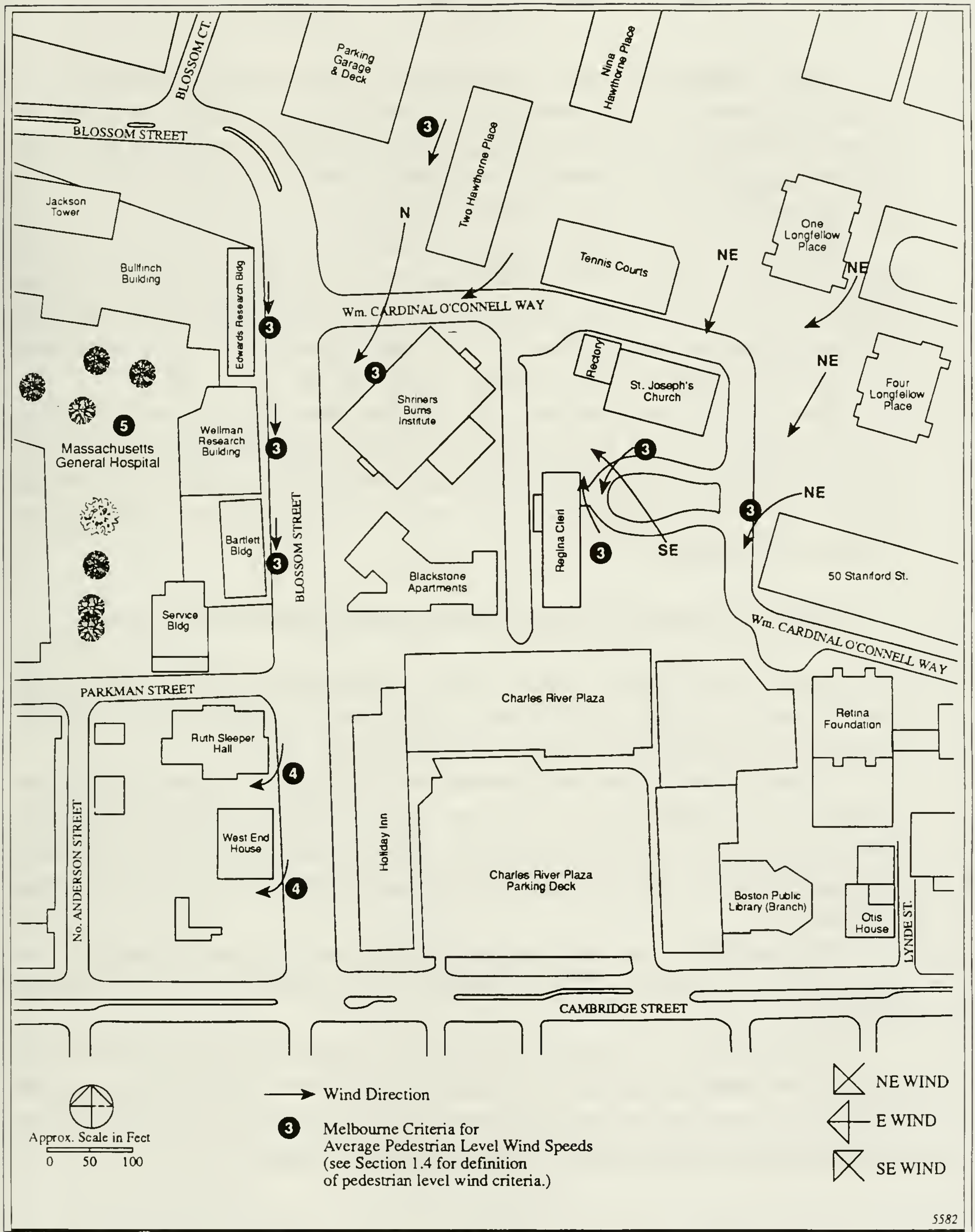

FIGURE V-1.15
EASTERLY (STORM) WINDS EXISTING CONDITIONS
Shriners Burns Institute

Finally, although the Main MGH Courtyard would not be used when there is precipitation during a storm, it probably is a very sheltered place for NNE, NE, ENE, and E winds (Category 5). The area around the West End House and Ruth Sleeper Hall probably experiences some windiness during NE storms, but because of the upwind buildings providing shelter, it is no worse than Category 4.

SE winds are the least likely to occur. For them, the entire area is in the lee of the Boston Financial District which contains many 25 to 40 story buildings. While these buildings are about ½ mile away, because the buildings are so tall, their shielding persists much longer than for lower buildings and is all encompassing. Thus, SE winds probably are of little consequence in the project area.

There are two areas where these SE winds may cause significant windiness in the existing conditions; i.e., on the path between St. Joseph's Rectory and the Regina Cleri Building, and at the main entrance to the Regina Cleri building (possibly as windy as high Category 3). This is a complicated situation because of the very tall upwind buildings, and a definitive evaluation is difficult.

Impact of the Proposed Project on Easterly (Storm) Winds (Figure V-1.16)

It was pointed out above that for NNE, NE, ENE and E winds the area near the main entrance to St. Joseph's Church may be quite windy. Any such windiness would be unaffected by the Replacement Facility which is downwind.

For these winds from the NE quadrant, the entrance to the proposed Replacement Facility on Wm. Cardinal O'Connell Way may be windy (Category 3), but the entrance on Blossom Street will be sheltered (Category 5). The windiness at entrances to the Edwards, Wellman, and Bartlett Buildings may experience some increase, but to no worse than high Category 3.

The Main MGH Courtyard would still be a very sheltered place (Category 5). The winds in the area around the West End House and Ruth Sleeper Hall will be essentially unchanged.

For SE winds, the two main entrances to the Replacement Facility will be in the shelter of the building. Also, the Replacement Facility may cause the winds on the path between St. Joseph's Rectory and the Regina Cleri Building to be reduced, but those at the main entrance to the Regina Cleri Building will remain unchanged.

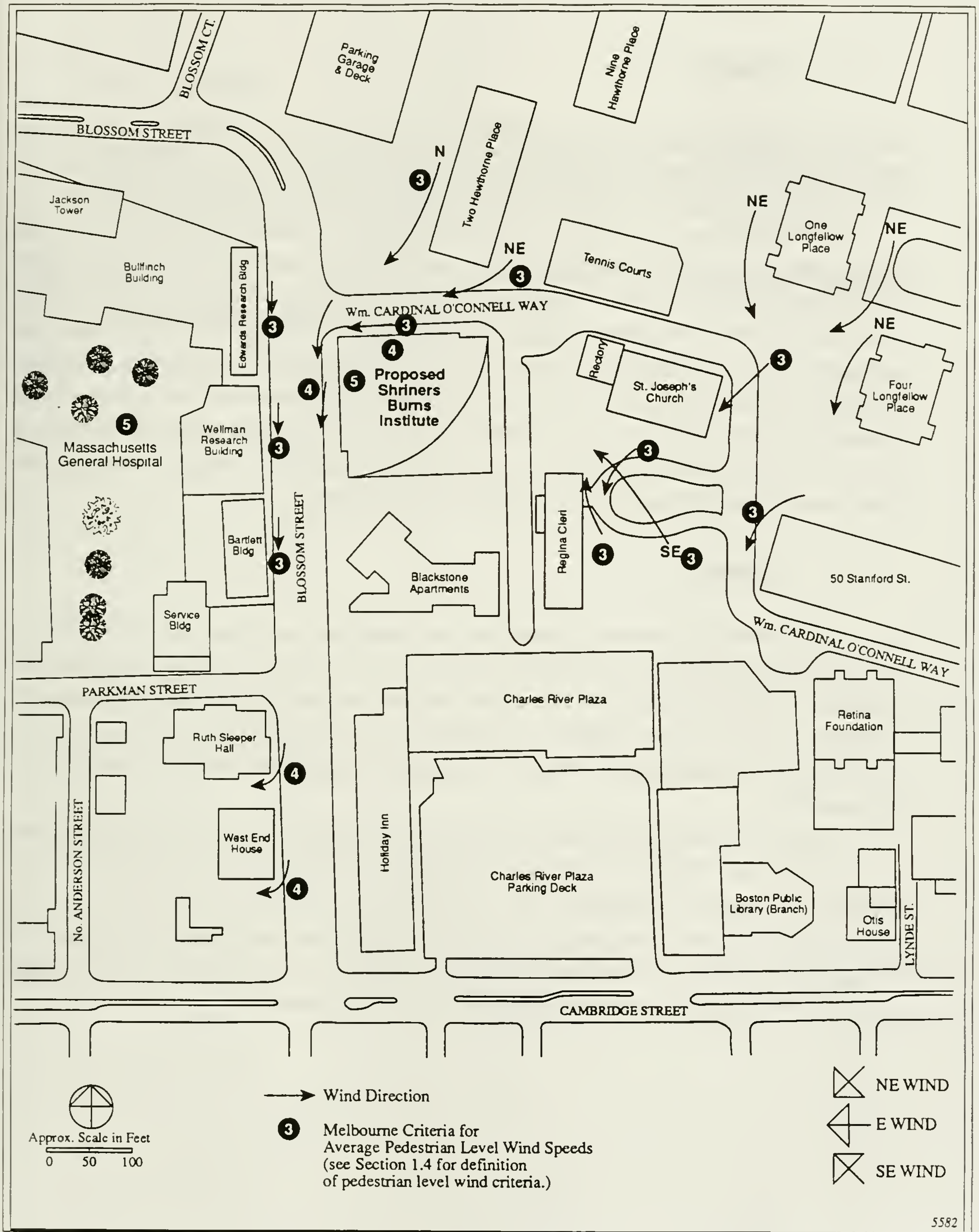

FIGURE V-1.16
EASTERLY (STORM) WINDS PROPOSED CONDITION
Shriners Burns Institute

1.6 Mitigation

The proposed project has been designed to be generally consistent in height and massing as many of the other structures surrounding the site. From a wind standpoint, the project will not significantly redirect upper level, higher wind speeds toward ground level.

Little difference is expected from project impacts already discussed, with initial construction of the project's upper portion. Once the upper portion is completed and the lower portion removed, typical practice is to enclose the construction area with a fabric sheeting material. This fabric material contains small holes for ventilation and also mitigates construction impacts beyond the site. The openings of this sheeting material represent less than 50% of the total area and, therefore, winds will be restricted from flowing unimpeded below the upper portion of the project, once demolition of the existing structure occurs. Further, because some wind will be able to flow through the construction area, winds around the building corners will also be diffused.

1.7 Summary

A qualitative assessment of pedestrian level winds was conducted to find the effect of replacing the four-story existing Shriners Burns Institute with a nine-story Replacement Facility. No location in the site is currently believed to have winds that are excessive or exceed the BRA guideline effective gust wind speed of 31 mph once per 100 hours. The addition of the Replacement Facility is not expected to cause the guideline wind speed to be exceeded.

Because of climate and location, winds from the northwest pose the primary concern for this project. While for NW wind directions, one of the two entrances to the Replacement Facility is expected to be somewhat windy, the other entrance will not be windy. The winds at the entrances to the Bartlett, Wellman, and Edwards Buildings will be slightly increased, but not significantly. The winds in the Main MGH Courtyard and around Ruth Sleeper Hall and West End House will be unaffected.

1.8 References

(1) Davenport, A.G., and Isyumov, N., 'The Application of the Boundary Layer Wind Tunnel to the Prediction of Wind Loading', Proceedings of Intl. Seminar on Wind Effects on Buildings and Structures, Ottawa, Canada, September, 1967.

(2) Melbourne, W.H., 'Criteria for Environmental Wind Conditions', Journal of Industrial Aerodynamics, Vol. 3, 1978, pp. 241-249.

2.0 SHADOW ANALYSIS

2.1 Introduction

The scope for the DEIR/DPIR required examination of shadow impacts from the proposed Shriners Replacement Facility during four time periods (9:00 AM, 12:00 Noon, and 3:00 PM) during the Vernal Equinox (March 21), the Summer Solstice (June 21), the Autumnal Equinox (September 21) and the Winter Solstice (December 21).

For most of the periods studied, the impacts are limited to abutting properties or across Blossom Street and William Cardinal O'Connell Way. During the Winter Solstice, new shadows extend beyond Blossom Street in the morning and beyond Longfellow Place Towers in the afternoon. Additional studies have been conducted for this FEIR in response to the Secretary's Certificate. These studies address the potential impacts on the surrounding vegetation during the Vernal Equinox. In addition, shadow diagrams were prepared to compare the relative impacts of a slightly lower facility (one less floor).

The existing and new shadows associated with the proposed project are discussed below by time period.

2.2 Vernal Equinox (March 21)

New morning shadows during the Spring (Figure V-2.1) cross Blossom Street northwest of William Cardinal O'Connell Way and extend for a short distance along the eastern sidewalk along Blossom Street in front of MGH's Edwards Building. They also cross Blossom Street in a narrow band to a portion of the front of the Wellman Building.

By noon, the existing shadow is near the base of the south face of Two Hawthorne Place, depicted in Figure V-2.2. Shadow impact from the Replacement Facility extends vertically approximately 21 feet up the building's south face. At noon some existing shadow along the east side of the rear driveway as well as Blossom Street's frontage is removed with the new facility.

At 3:00 PM, existing shadows (Figure V-2.3) are visible approximately 15 feet vertically on the west face of St. Joseph's Rectory. New shadows from the Replacement Facility extend up along the entire windowless west facade of St. Joseph's Church Rectory. The Hawthorne Place tennis courts are also partially in new shadow as well as a portion of sidewalk on the north side of William Cardinal O'Connell Way. However, the new facility will eliminate some existing shadow on the walkway and vegetation between the Rectory and Regina Cleri during the Vernal Equinox at 3:00 PM.

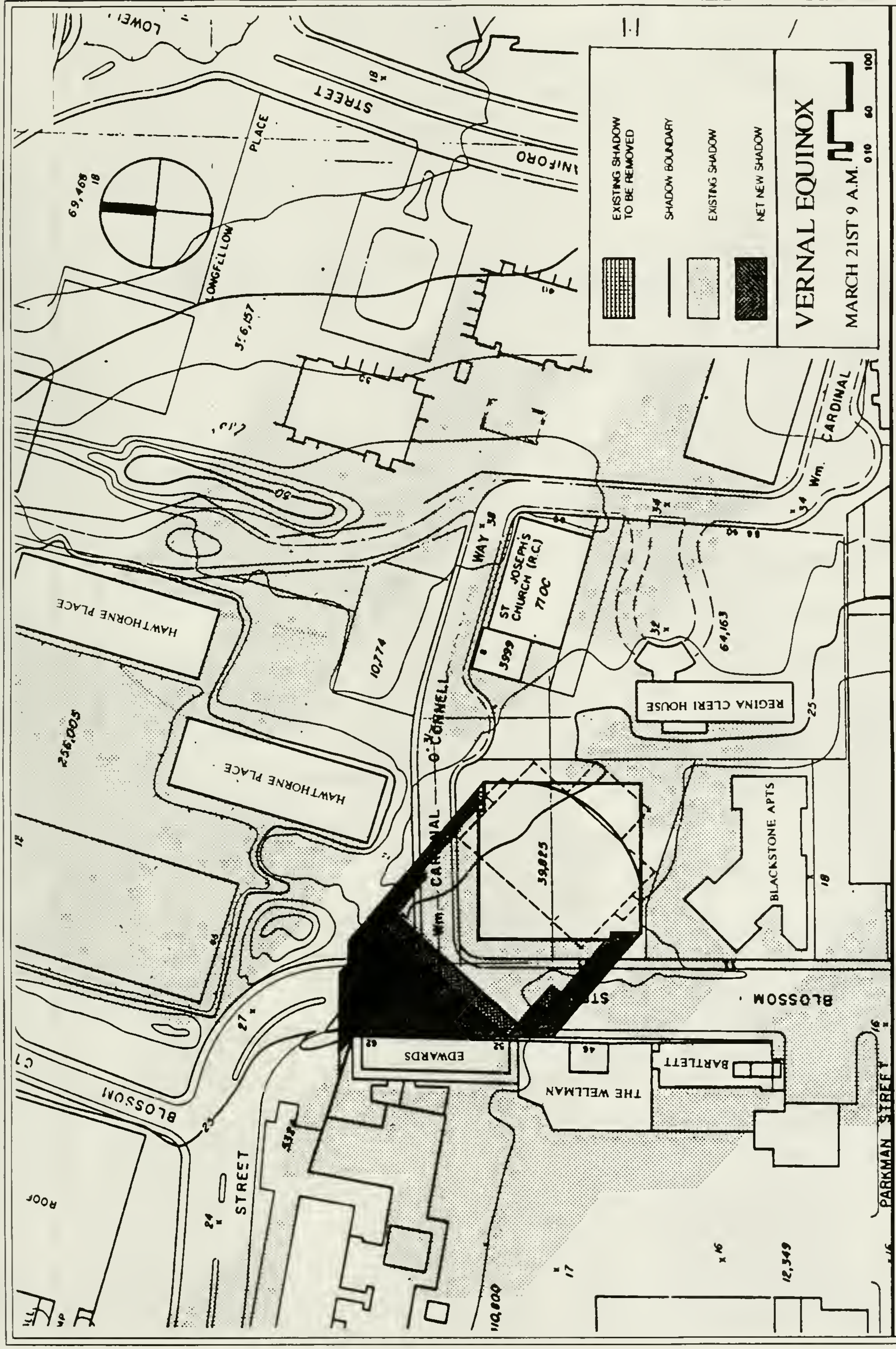

FIGURE V-2.1
VERNAL EQUINOX
March 21st 9:00 AM

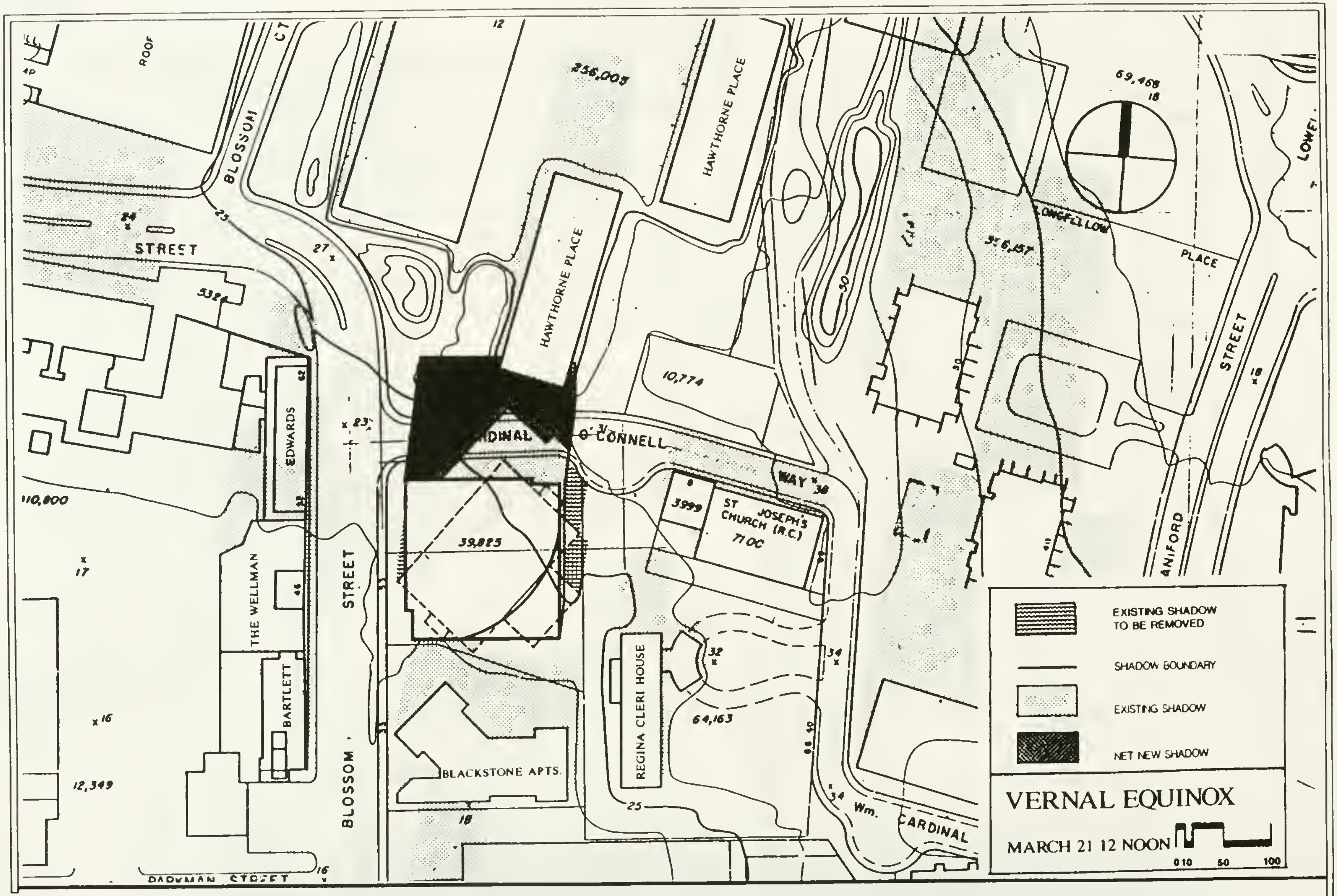

FIGURE V-2.2
VERNAL EQUINOX
March 21st 12:00 Noon

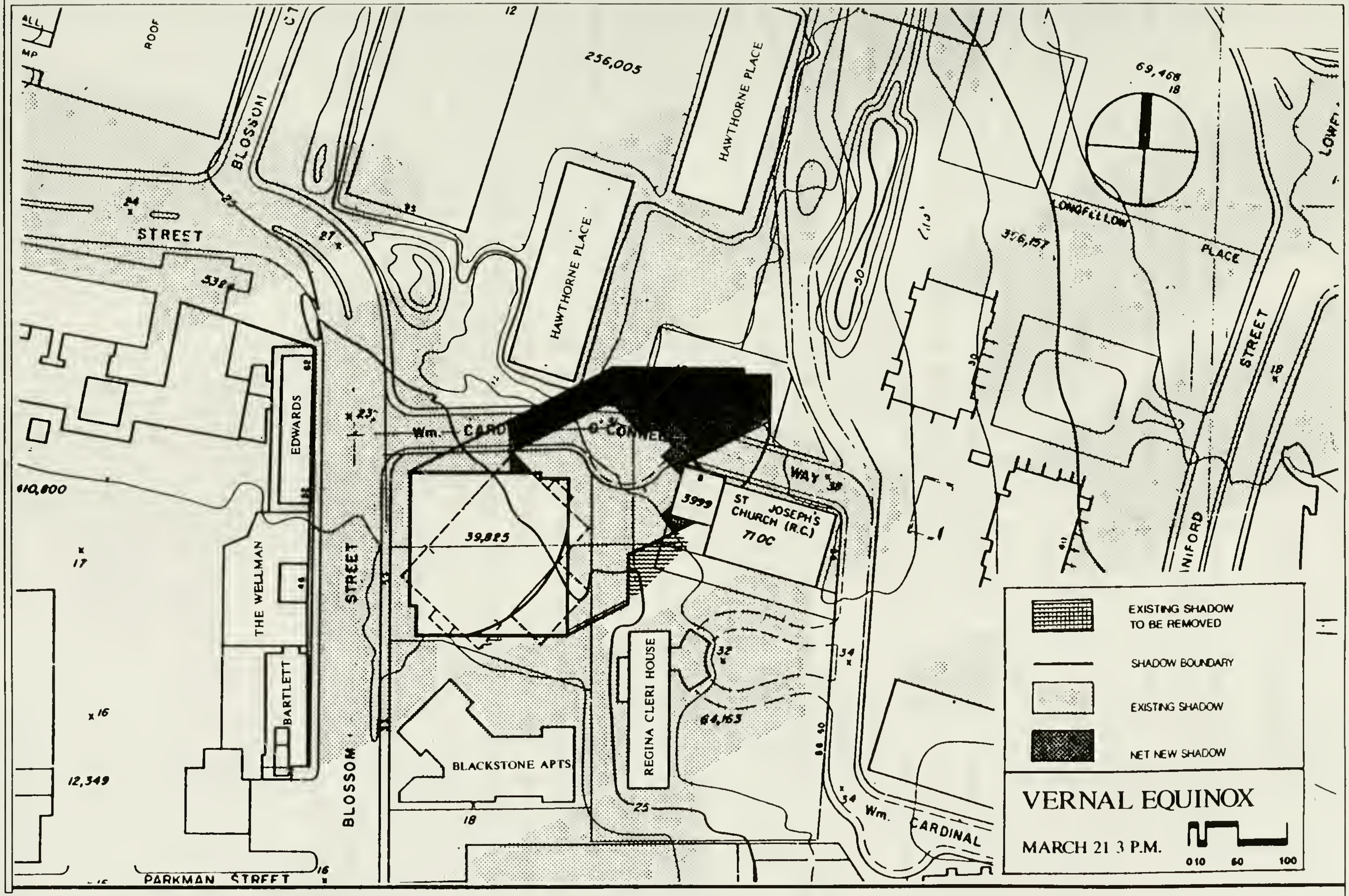

FIGURE V-2.3
VERNAL EQUINOX
March 21st 3:00 PM

2.3 Summer Solstice (June 21)

New morning shadows in the summer (Figure V-2.4) cross Blossom Street due west of the Shriners Replacement Facility and cover the western sidewalk in front of portions of MGH's Edwards and Wellman buildings. There is some existing shadow reduction by the new facility along the south side of William Cardinal O'Connell Way and adjacent to the project in the summer mornings. By noon, new shadows are very limited as shown in Figure V-2.5. They occur primarily to the southeast of the Blossom Street/William Cardinal O'Connell Way intersection along the project and on the southern half of William Cardinal O'Connell Way directly adjacent to the north side of the Replacement Facility. There is also some increased sunlight along the east side of the rear driveway between the existing building and the St. Joseph's Rectory.

At 3:00 PM, the turnaround area to the rear of the Shriners' loading driveway is partially in shadows from the new facility as is a portion of the south sidewalk along William Cardinal O'Connell Way. Net new shadows as shown in Figure V-2.6, however, are limited to a small area around the northeast side of the project. Limited existing shadow reductions occur along the east side of the rear driveway and adjacent to the Blackstone Apartments from the new facility in the summer afternoons.
feet vertically on the west face of the St. Joseph's Rectory. New shadows from the Replacement Facility extend up along the entire windowless west facade of St. Joseph's Church rectory. The Hawthorne Place tennis courts are also partially in new shadow as well as a portion of sidewalk on the north side of William Cardinal O'Connell Way. However, the new facility will eliminate some existing shadow on the walkway and vegetation between the Rectory and Regina Cleri during the Vernal Equinox at 3:00 PM.

The proposed Replacement Facility does not cast shadows on the south side of Two Hawthorne Place in either the existing or build conditions for the time periods studied. Thus, the existing vegetation in front of the building will be in sunlight for much of the day during this time period and is therefore not affected by the project. In addition, the project does not cast new shadow on the wall of St. Joseph's Rectory.

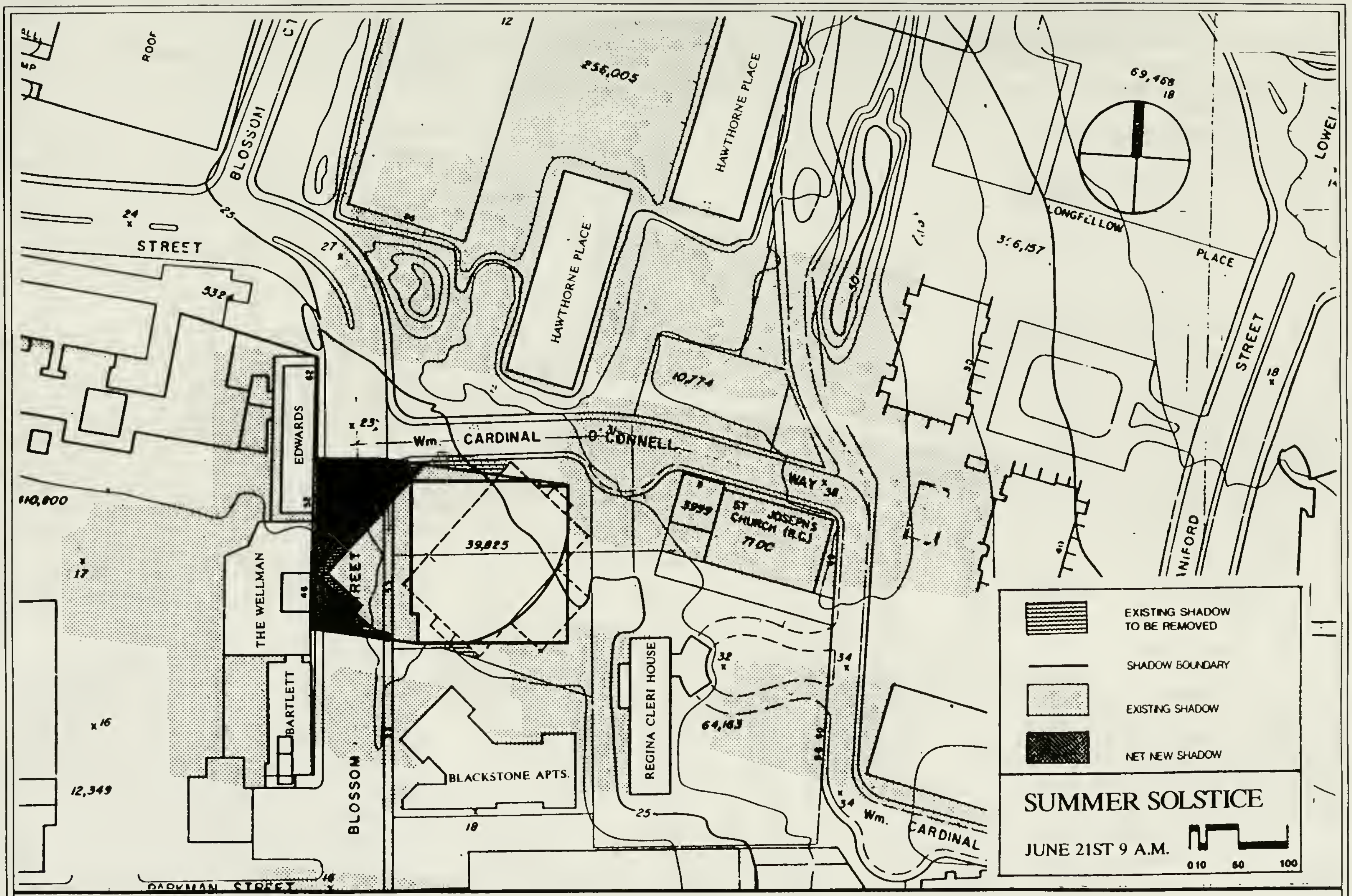

FIGURE V-2.4
SUMMER SOLSTICE
June 21st 9:00 AM

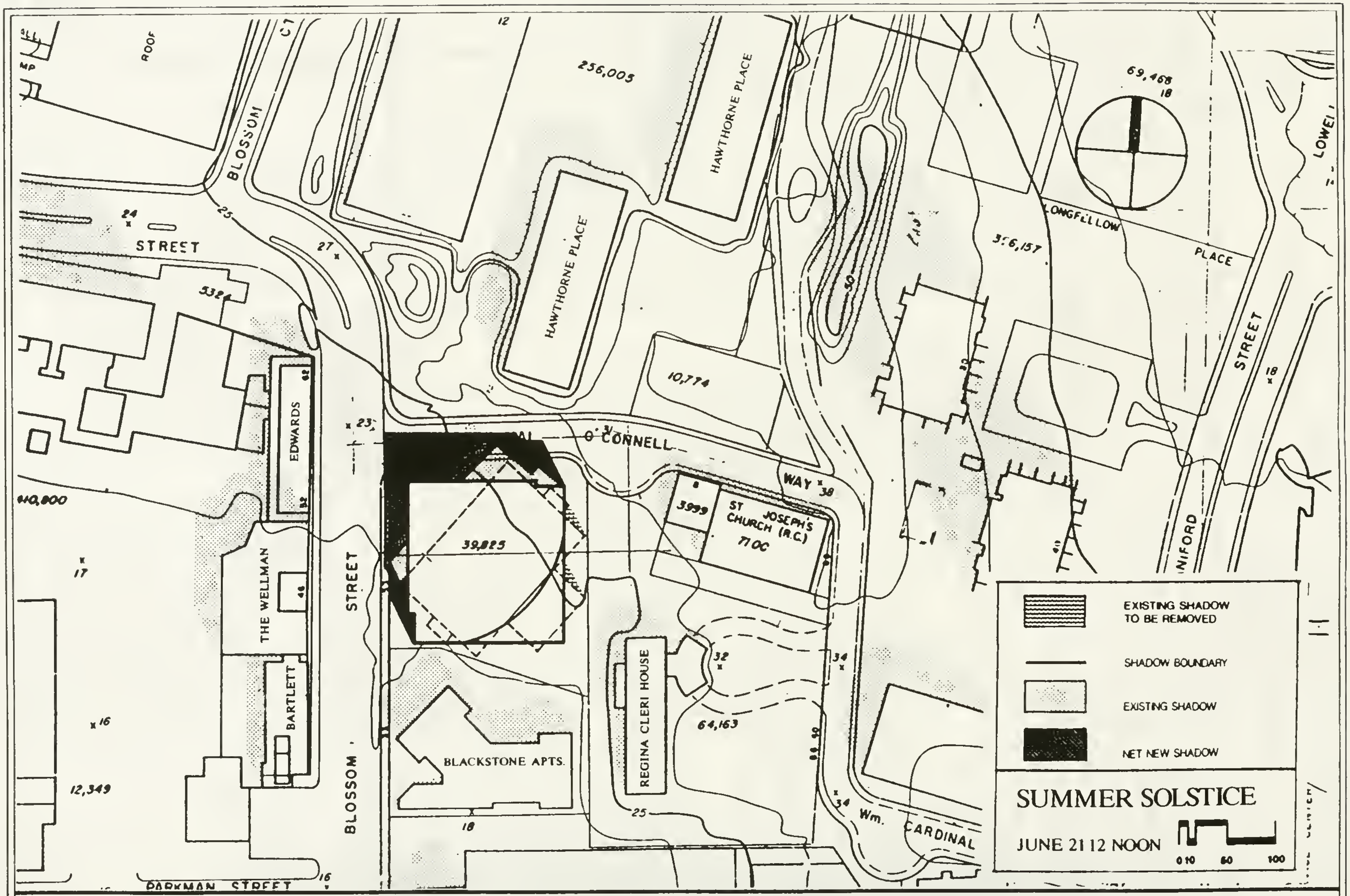

FIGURE V-2.5
SUMMER SOLSTICE
June 21st 12:00 Noon

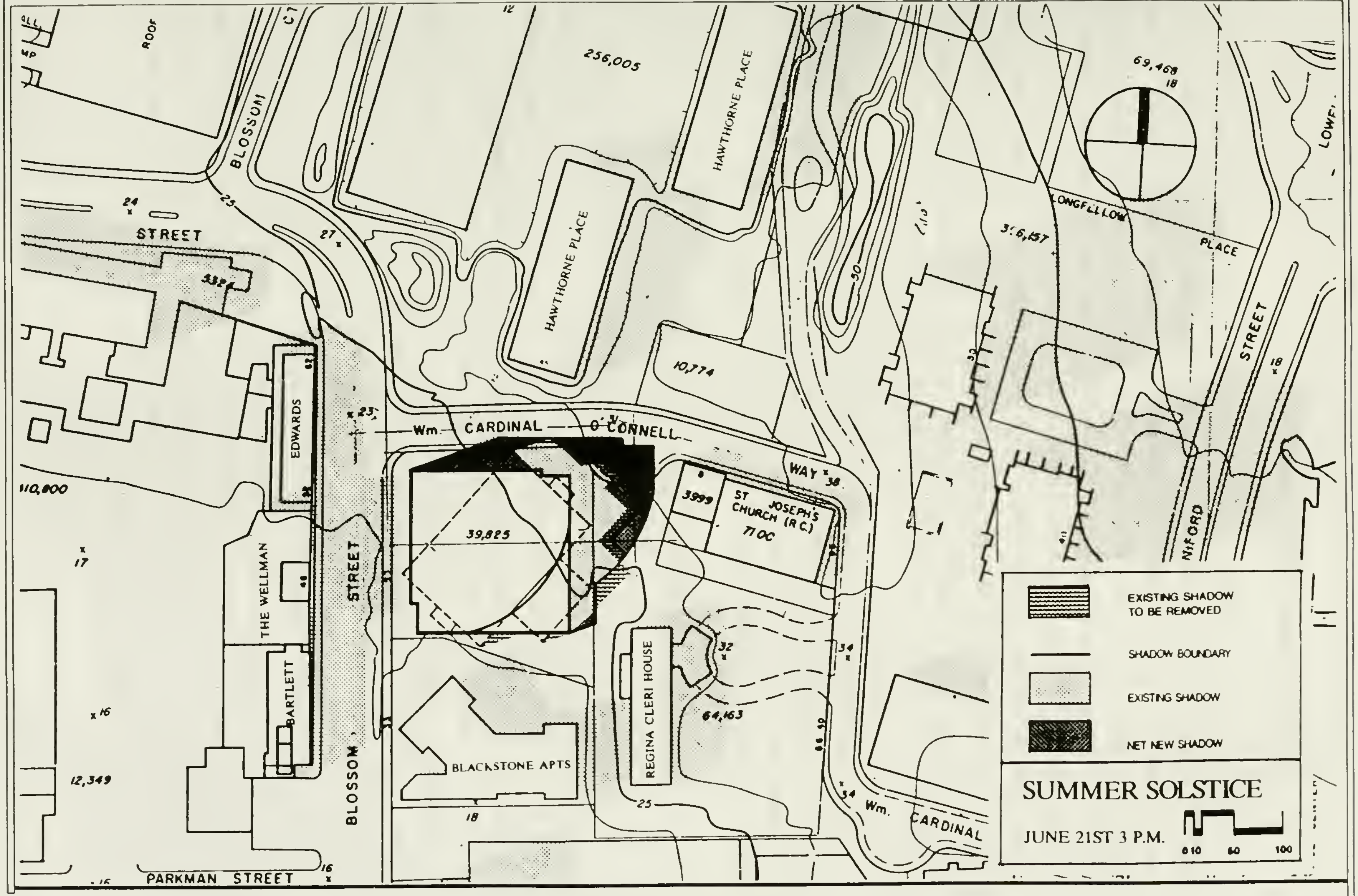

FIGURE V-2.6
SUMMER SOLSTICE
June 21st 3:00 PM

2.4 Autumnal Equinox (September 21)

There is some new morning shadow from the Replacement Facility in the Fall (Figure V-2.7) in front of the Edwards Building at its east side corner, and a narrow band crossing Blossom Street at the Wellman Building. At noon, new shadows shown in Figure V-2.8 cover portions of the Two Hawthorne Place access drive and the vegetated island area to the north of William Cardinal O'Connell Way. The new shadow also extends 18 vertical feet on half of the south face of Two Hawthorne Place.

By 3:00 PM, the new shadow area (Figure V-2.9) covers the southwest corner of the Hawthorne Place tennis courts and portions of the sidewalk to the north of William Cardinal O'Connell Way. Similar to the shadows at 3:00 PM during the Vernal Equinox, existing shadows to the east and in the rear driveway are removed by the Replacement Facility.

Similar to the Vernal Equinox, there will be some increased shadow on vegetation, but impacts to the vegetation are expected to be minimal, particularly since the vegetation will be going into the dormant phase during this period. (See Section 2.6 below for more detailed evaluation of vegetation impacts during the Vernal Equinox.)

2.5 Winter Solstice (December 21)

At 9:00 AM during the winter, new shadows (Figure V-2.10) extend into portions of Blossom Court, and the surface parking deck at Emerson Place. A narrow band of new shadow is also added from the northeast edge of the Shriners Facility through Charles River Park, and over a corner of the surface parking deck at Two Hawthorne Place.

At noon, new shadow (Figure V-2.11) extends into the front of Two Hawthorne Place and up the south face of Two Hawthorne Place (from 17 vertical feet in the existing condition to 88 vertical feet with the Replacement Facility). At noon, previous shadows on the east side of the rear driveway and crossing William Cardinal O'Connell Way east of Two Hawthorne Place are removed with the Replacement Facility.

The longest shadows examined occur at 3:00 PM on December 21. These are shown in Figure V-2.12. Existing shadows at this time extend behind Two Hawthorne Place. New shadows from the Replacement Facility occur to the north of the Longfellow Place Towers and extend to the east of the Charles River Lomasney Way Garage. New shadow on the south face of Two Hawthorne Place extends from a height of 33 feet with the existing condition to 104 feet with the Replacement Facility.

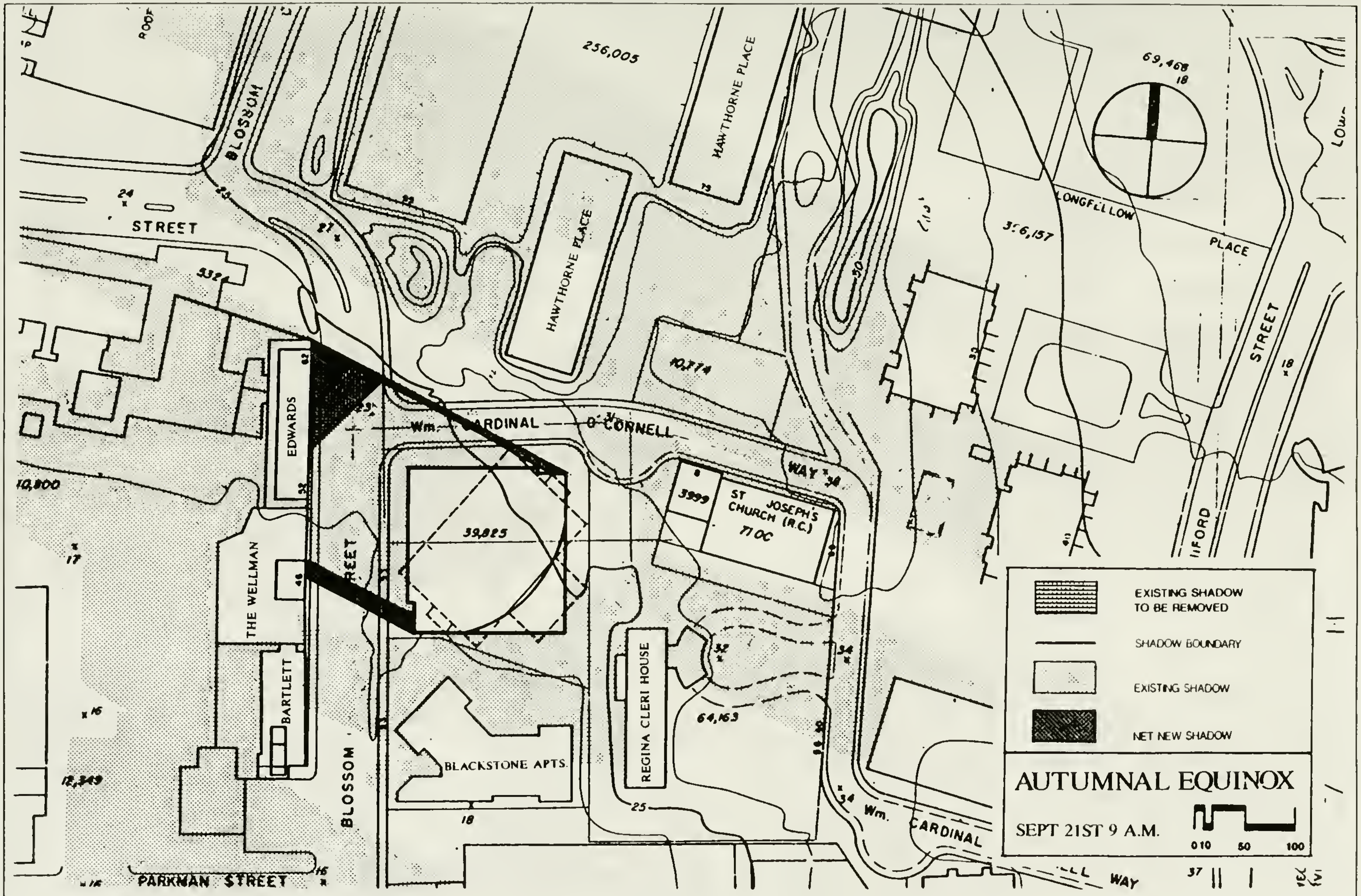

FIGURE V-2.7
AUTUMNAL EQUINOX
September 21st 9:00 AM

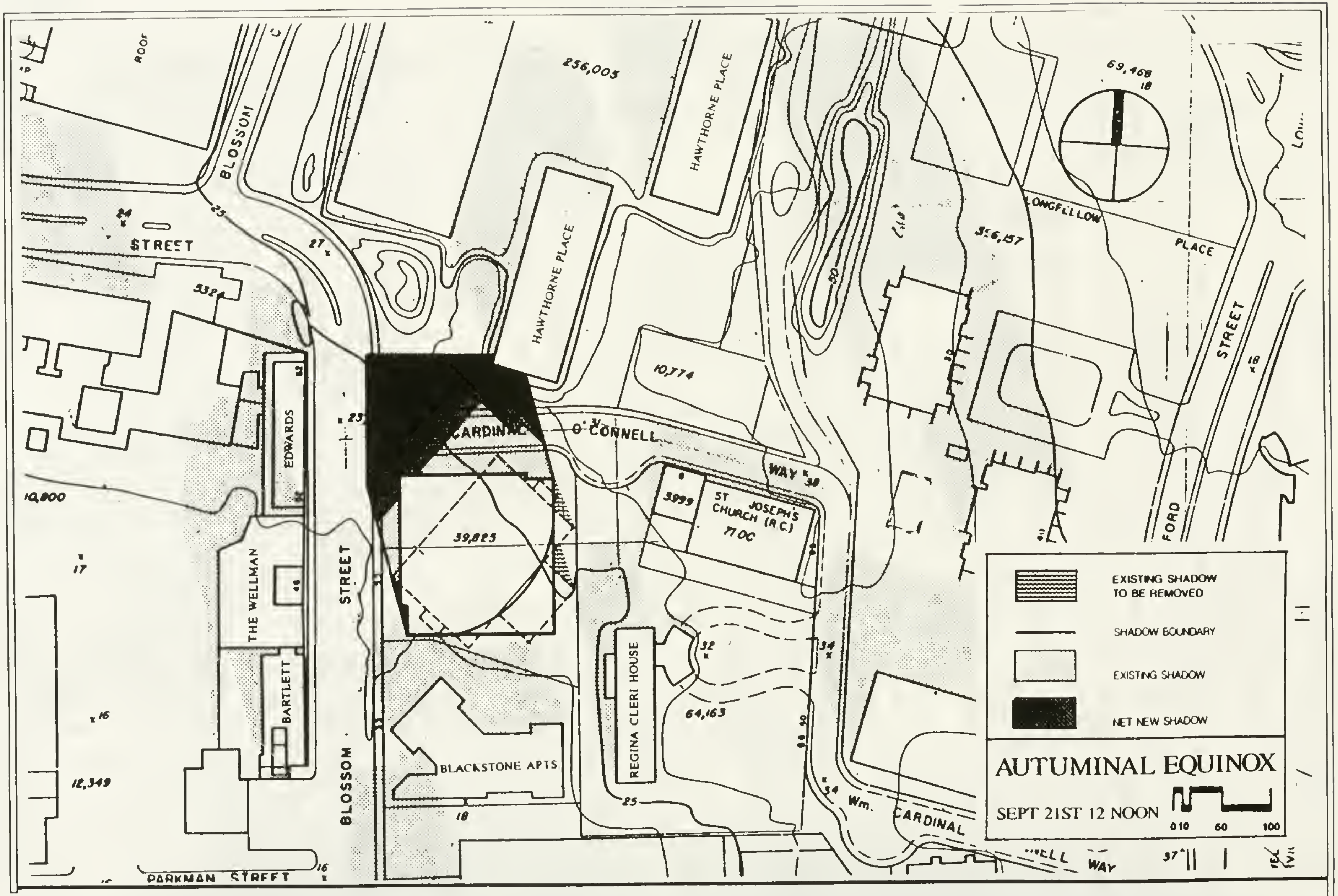

FIGURE V-2.8
AUTUMNAL EQUINOX
September 21st 12:00 Noon

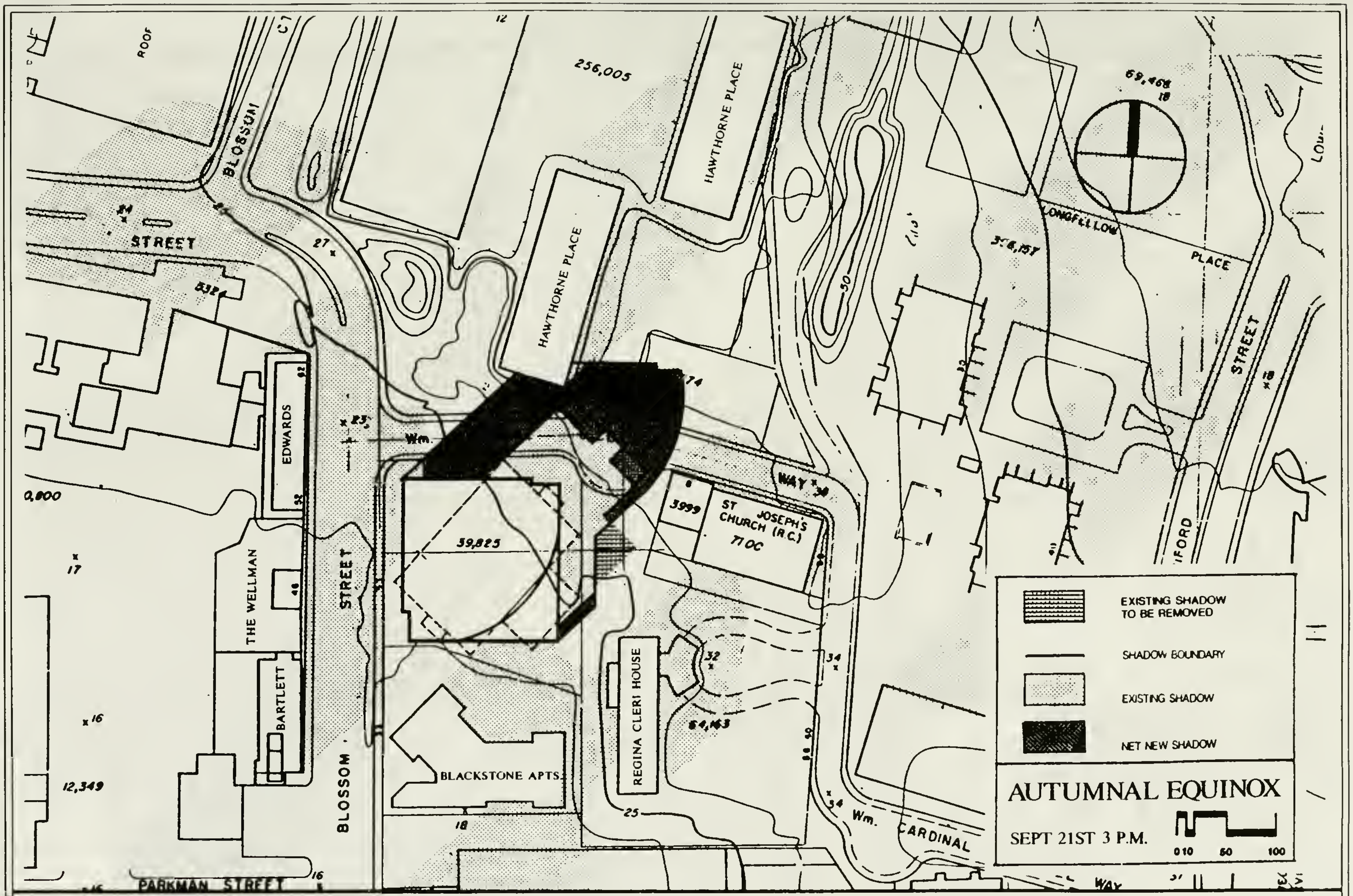

FIGURE V-2.9
AUTUMNAL EQUINOX
September 21st 3:00 PM

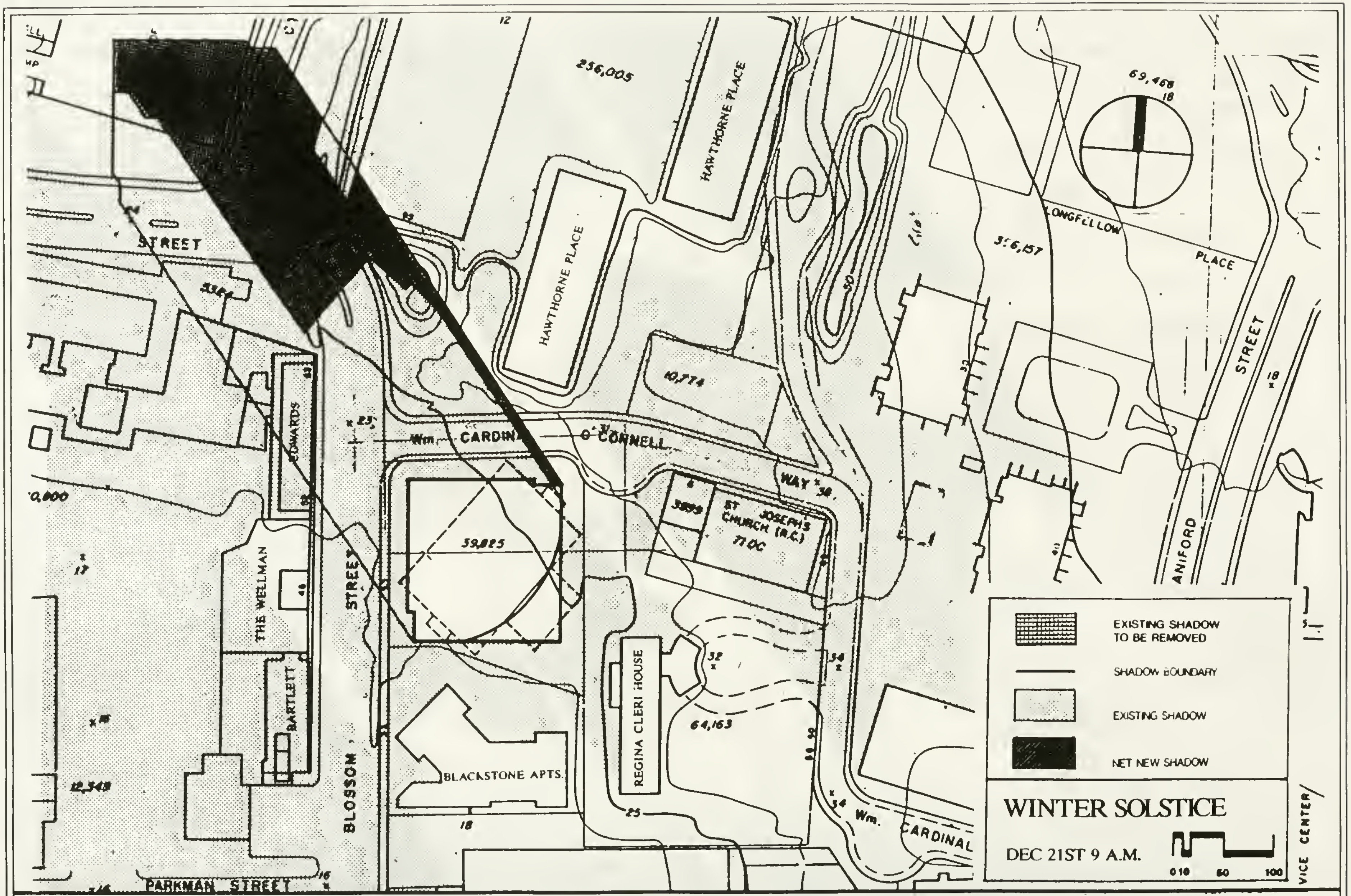

FIGURE V-2.10
WINTER SOLSTICE
December 21st 9:00 AM

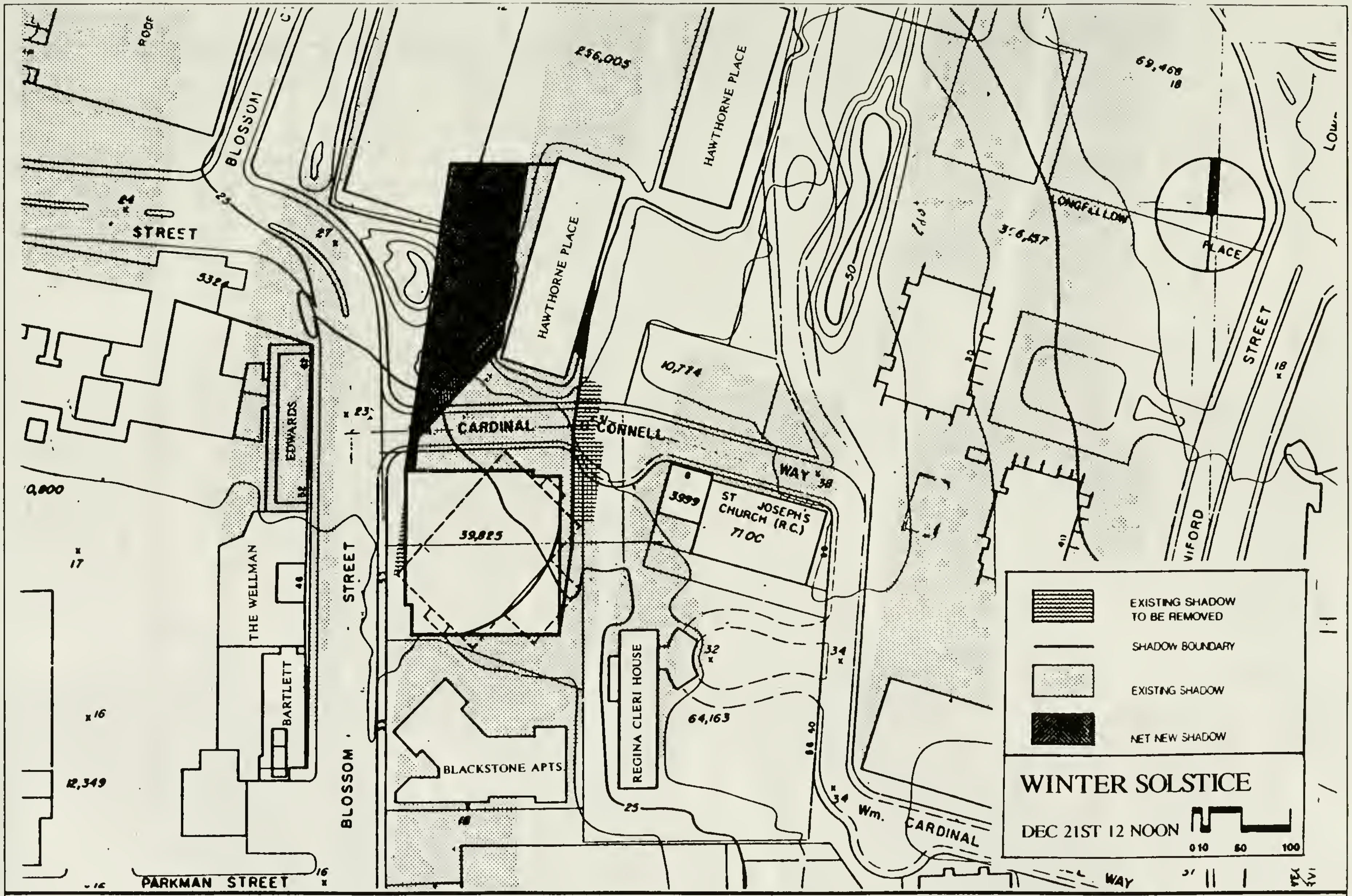

FIGURE V-2.11
WINTER SOLSTICE
December 21st 12:00 Noon

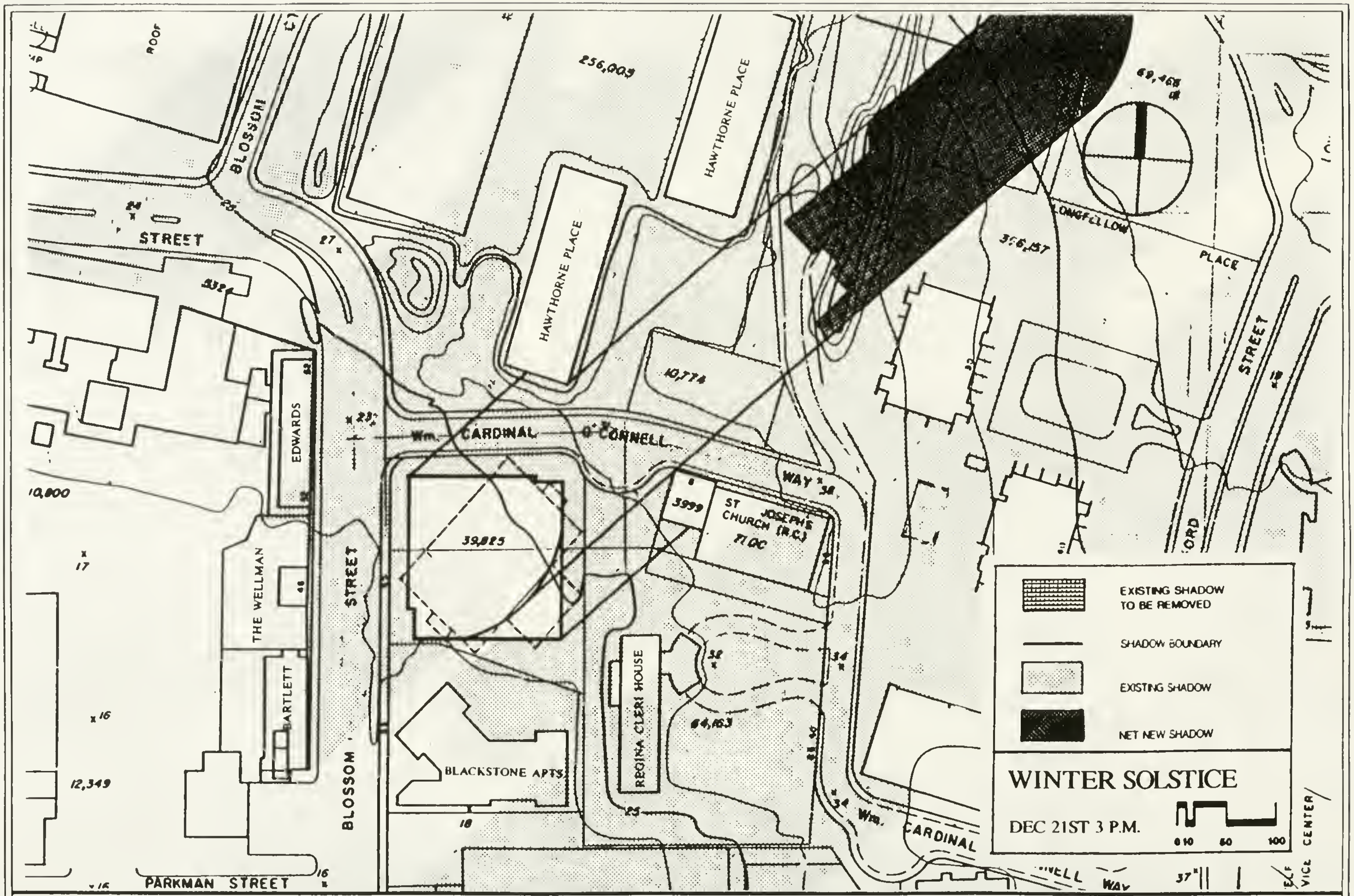

FIGURE V-2.12
WINTER SOLSTICE
December 21st 3:00 PM

2.6 Effects of Additional Shading on Vegetation

The effects of new shadows associated with the proposed Shriners Replacement Facility on the vegetation of Two Hawthorne Place and St. Joseph's Rectory has been further analyzed based on comments outlined in the Secretary's Certificate on the DEIR. Specifically, the effects of new shadows cast during the Vernal Equinox (March 21) during the time periods of 9:00 AM, 12:00 Noon, and 3:00 PM have been examined utilizing the shadow analysis results presented in the DEIR/DPIR and in this section. An inventory was conducted of the existing vegetation at Two Hawthorne Place and along the western face of St. Joseph's Rectory, and the tolerance of these plant species to shade was evaluated. These investigations were conducted by environmental scientists.

Vegetation was identified during a field survey conducted in the month of February 1992. The vegetation identified was limited to various ornamentals used for landscaping. No native vegetation was identified. The individual plant specimens were identified to Family and Genus. Species identification was not always possible due to the fact that the plants are ornamentals with a wide range of species utilized in the area, combined with the seasonal constraints resulting in the absence of flowers and leaves. Irrespective of this, the plant specimens appear to have been selected in part due to their tolerance to fluctuations in certain parameters that can otherwise affect growth, such as temperature, shade and pollution. Fluctuations and changes in these parameters are common in city settings.

According to the U.S. Department of Agriculture,* the growing season for the Boston area extends from the end of March to October. The average temperatures for July reach 70°F, while in January the temperature is more variable, ranging from approximately 25°F inland to 36°F on the coast (Jorgensen, 1978).** The U.S. Department of Agriculture has published a winter plant hardiness zone map for the United States and Canada. Winter hardiness refers to the survival of landscape plants over winter and was selected as the most critical criterion in their adaptation to the environment. The temperatures listed are based on the lowest temperatures recorded for each of the years 1974 to 1986. The Boston area falls within zone 6a with limiting temperatures of -5°F to -10°F.

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* U.S. Department of Agriculture. Soil Taxonomy. Soil Conservation Service. US Department of Agriculture Handbook. 1975.

** Jorgensen, N. A Sierra Club Naturalists's Guide to Southern New England. 1978.

Two Hawthorne Place

The areas where vegetation was inventoried at Two Hawthorne Place consist of planted areas. The first is located along William Cardinal O'Connell Way and the second is a small landscaped area between Blossom Street and Two Hawthorne Place. The vegetation along William Cardinal O'Connell Way consists of four (4) linden trees (Tilia americana) along with various ornamental shrubs including: Japanese yew (Taxus cuspidata) and azalea (Rhododendron sp.). The landscaped area, approximately 0.25 acres in size, along the west side of Two Hawthorne Place consists of a variety of ornamental trees and shrubs. A total of eight (8) honey locust trees (Gleditsia triacanthos), ten (10) magnolia trees (Magnolia sp.), twenty-three (23) azalea shrubs (Rhododendron sp.), eight (8) euonymus shrubs (Euonymus sp.), Japanese yew (Taxus cuspidata), three (3) barberry (Berberis sp.), and one (1) holly (Ilex sp.) were identified. In addition, maintained grass dominates the ground cover throughout this area.

As described previously, new morning shadows during the spring will cross Blossom Street northwest of William Cardinal O'Connell Way and extend for a short distance along the eastern sidewalk along Blossom Street in front of MGH's Edwards Building (Figure V-2.1). The new shadow will cover a small section of the landscaped area west of Two Hawthorne Place. Also during this time, Two Hawthorne Place casts an existing shadow that covers a section of the same landscaped area. New shadows will also cross Blossom Street in a narrow band to a portion of the front of the Wellman Building, but will not impact any additional vegetation.

By noon, the existing shadow cast by Two Hawthorne Place has subsisted over the landscaped area. New shadow impact from the Replacement Facility will extend vertically, approximately 21 feet up Two Hawthorne Place's south face. New shadow at this time will also cover a larger section of the landscaped area west of Two Hawthorne Place (Figure V-1.2).

At 3:00 PM, the new shadow will have moved away from the landscaped areas at Two Hawthorne Place, although a section of the Two Hawthorne Place tennis courts will be in new shadow (Figure V-2.3).

The three tree species - honey locust, linden, and magnolia - located within the influence of the new shadow, are considered shade tolerant (Dirr, 1983).* The honey locust flowers in May to June and can survive under a wide range of growing conditions.

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* Dirr, M. Manual of Woody Landscape Plants: Their Identification, Ornamental Characteristics, Cultures, Propagation and Uses. Stipes, Illinois, 1983.

Linden flowers from mid- to late-June and can tolerate full sunlight or partial shade. Soil conditions govern the growth rate in this species. The magnolia tree flowers from March through mid-April, prior to leaf-out. This ornamental tree can withstand partial shade and is commonplace in many city landscapes.

The variety of shrubs found within the landscaped area (rhododendron, yew, euonymus, holly, and barberry) are tolerant to partial shade or full shade (Dirr, 1983). The common Japanese yew has been developed to withstand the dust and smoke of city atmospheres. The euonymus and rhododendron are highly shade tolerant. The euonymus does well in heavy shade. The single holly shrub found within the landscaped area requires full sun for optimal growth, but can tolerate periods of partial shade.

In summary, from 9:00 AM to 12:00 noon, the northern section of the landscaped area west of Two Hawthorne Place is already shaded by that building. Similarly, a portion of the southwest corner of the area is shaded by the existing Shriners Building. Roughly 2,800 square feet (sf) of the landscaped area will be covered by new shadow at 9:00 AM during the Vernal Equinox. At 12:00 Noon, approximately 2,000 square feet of landscaped area and the zone between William Cardinal O'Connell Way and Two Hawthorne Place will be shaded. The existing shadow over the area from Two Hawthorne Place has receded by this time. An area approximately 1,000 sf, located in the southwest corner of the landscaped area will be in new shadow from 9:00 AM to approximately 1:00 PM (4 hours). By 3:00 PM, shadow associated with the proposed Replacement Facility will have moved away from the landscaped area and most of the zone bordering William Cardinal O'Connell Way. The western portion of the landscaped area at this time is partially shaded by the existing buildings along Blossom Street.

The overall increase in shade from two to four hours a day in such limited areas (ranging in size from 1,000 sf to no more than 2,800 sf), during the Vernal Equinox, should have little effect on the existing vegetation's productivity and development in the area of Two Hawthorne Place. The vegetation, as previously noted, is primarily shade tolerant. During the month of March, most of the plant species are still dormant or are just beginning to emerge from dormancy. In spite of the intervals of new shade, indirect light from reflection off adjacent buildings will be available to the vegetation during these periods. As a result, negative impacts to the growth of the vegetation along Two Hawthorne Place from the short increases in shade from the Replacement Facility are not expected.

St. Joseph's Rectory

The vegetation found along the western face of the Rectory was identified. A total of two (2) Japanese flowering cherry trees (Prunus serrulata) and one (1) maple (Acer platanoides) were identified in this area. In addition, a variety of ornamental shrubs were recorded including seven (7) hemlocks (Tsuga canadensis), Japanese yew (Taxus cuspidata), barberry (Berberis sp.), and one (1) Japanese andromeda (Pieris japonica).

During the Vernal Equinox at 3:00 PM, St. Joseph's Rectory is covered by shadow emanating from the existing Shriners Building. The existing shadows are visible approximately 15 feet vertically on the west face of the Rectory. New shadows from the Replacement Facility will extend up along the entire windowless west facade of the Rectory (Figure V-2.3).

The two tree species - cherry and maple - flower in April and are used extensively in urban landscapes (Dirr, 1983). The cherry is used abundantly from Boston to Atlanta and is tolerant to periods of shade. The maple is extremely tolerant of the polluted atmospheres in urban settings and can withstand exposure to ozone and sulfur dioxide. The maple is also shade tolerant. The various shrubs identified along the west face of the rectory are all shade tolerant (Dirr, 1983). The hemlock withstands shade well and is often planted in areas where shade is prominent. The yew and barberry can withstand partial shade or full shade and the Japanese andromeda is tolerant to partial shade or full sun.

As previously noted, at 3:00 PM during the Vernal Equinox, the west face of the Rectory is already shaded by the existing Shriners Building. New shadows from the proposed Replacement Facility will only extend further up the face of the Rectory. The width of the existing shadow will also be increased approximately 30 feet. However, due to the configuration of the existing building, this increase will not affect the duration of shading. In fact, the new facility will reduce some of the existing shadow on the vegetation between the Rectory and the Regina Cleri. Overall, the vegetation will therefore not be subjected to any detrimental additional shade from the proposed Replacement Facility.

2.7 Analysis of Alternative Reduced Height Building

Comments on the DEIR/DPIR requested that additional height reductions of the Replacement Facility be investigated. This is discussed in detail in Section III and in Section IX - Responses to Comments. To respond to this request, additional shadow diagrams were prepared to compare the relative shadow impacts of a building with one less floor to those predicted for the proposed project. Shadow diagrams were prepared for the Vernal Equinox at 12:00 Noon and 3:00 PM (see Figures V-2.13 and V-2.14) and for the Winter Solstice at 12:00 Noon (Figure V-2.15), when shadows are long. As is seen in these figures, the shadowing of a reduced height building would produce essentially the same amount of shadowing as the proposed structure.

2.8 Mitigation

The project has been designed to minimize shadow impacts on the surrounding properties as much as possible. The rear of the building has been rounded at the upper levels to enhance views and allow for more sunlight to reach the back areas along William Cardinal O'Connell Way and St. Joseph's Church and Regina Cleri. The height of the building has been reduced as much as possible while still creating a new facility that will adequately serve the needs of the Burns Institute.

2.9 Conclusions

Minimal new shadow impacts associated with the Replacement Facility are evident during the warmer time periods (Spring, Summer, and Fall) in the morning and at noon. Later in the day, at 3:00 PM during the Spring, new shadows are added to a small portion of the west facade of the St. Joseph's Rectory. During the winter condition, the project adds some new shadow further away from the project, however, the immediate area is already heavily shadowed.

Additional minor shading at Two Hawthorne Place and the west face of St. Joseph's Rectory should have no effect on the growth cycles of the vegetation in these areas.

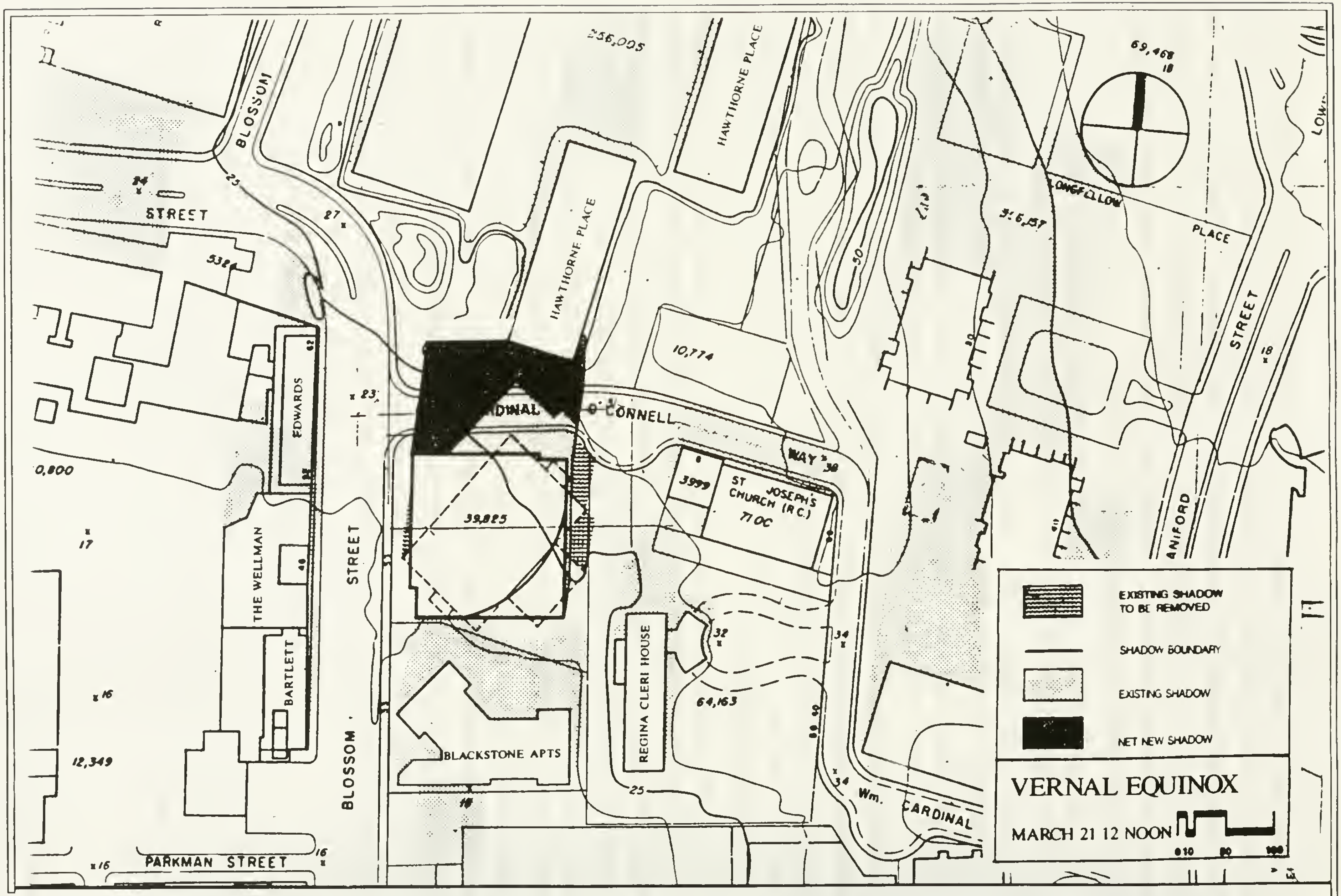

FIGURE V-2.13
VERNAL EQUINOX - SHADOW AT REDUCED HEIGHT
March 21st at 12:00 Noon

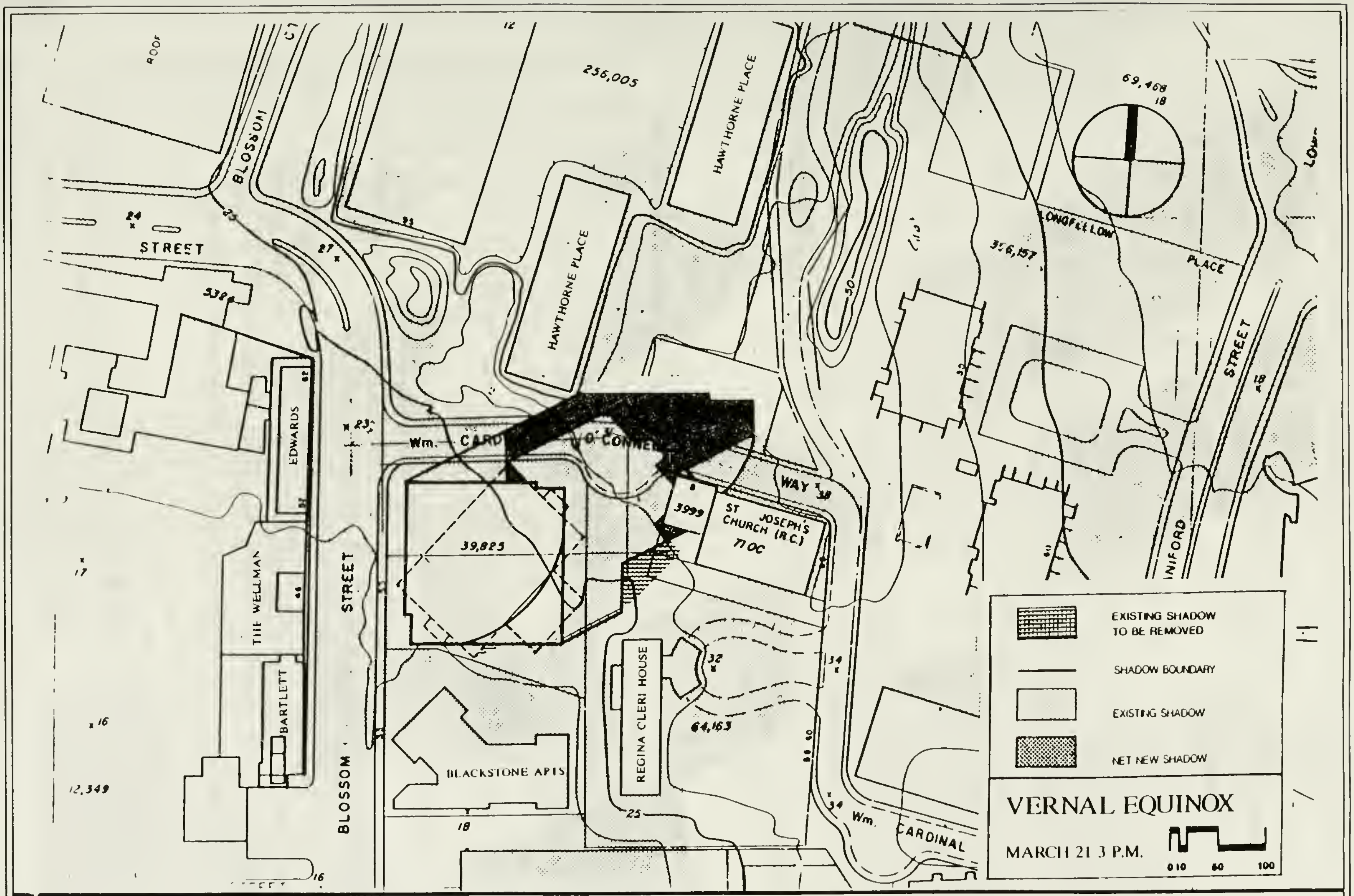

FIGURE V-2.14
VERNAL EQUINOX - SHADOW AT REDUCED HEIGHT
March 21st at 3:00 PM

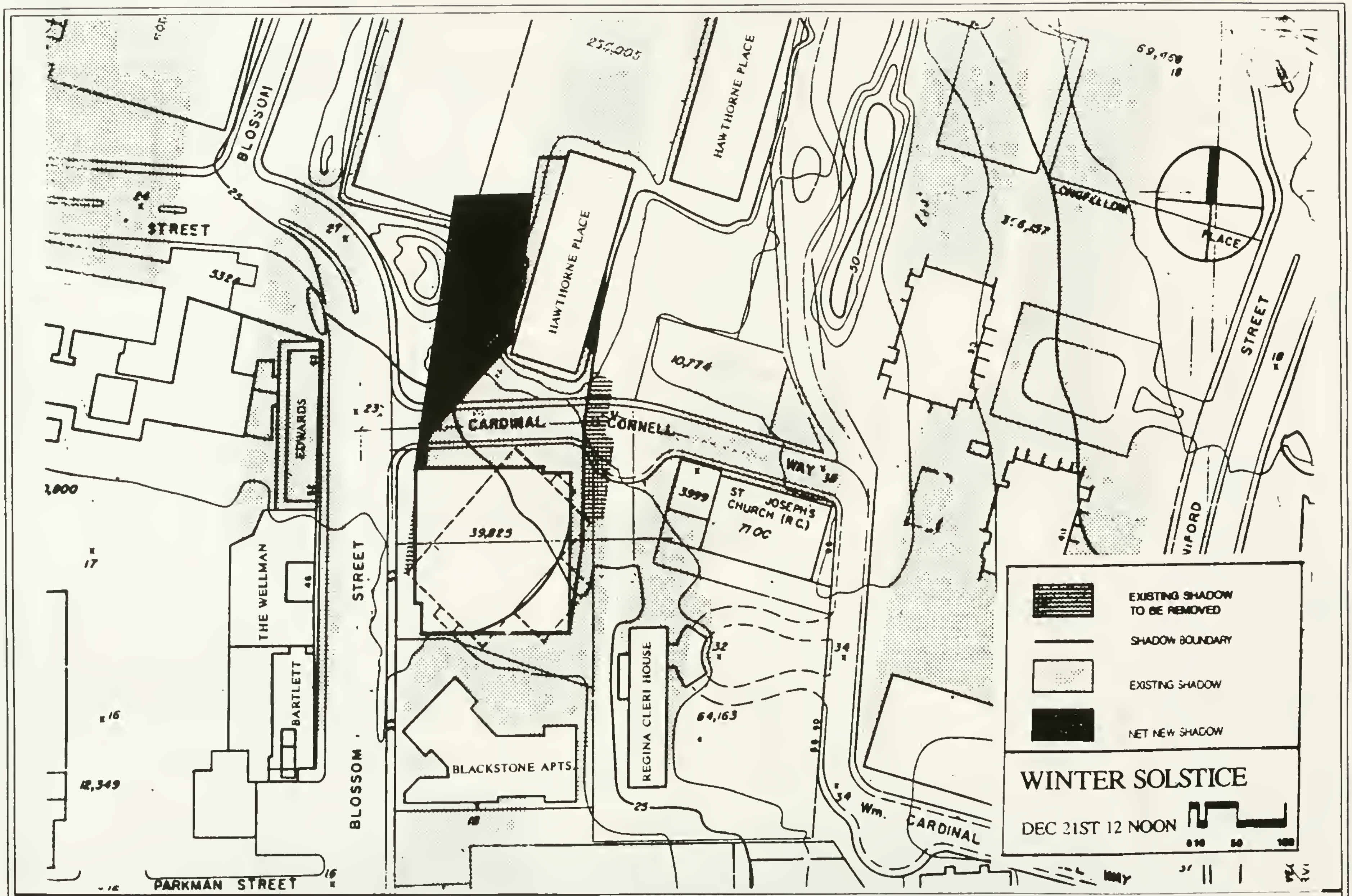

FIGURE V-2.15

WINTER SOLSTICE - SHADOW AT REDUCED HEIGHT

December 21st 12:00 Noon

3.0 DAYLIGHT ANALYSIS

3.1 Introduction

The purpose of the daylight analysis is to estimate the extent to which the proposed Shriners Burns Institute affects the amount of daylight reaching the street level. In accordance with the BRA scope, the analysis is limited to the proposed building alone (not in the context of other existing structures along Blossom Street or William Cardinal O'Connell Way). The scope also requires that the differences in daylight between the no-build (existing) and future build (Shriners proposal) be measured in the analysis. With regard to the frontage along both streets potentially impacted from reductions in daylight, the linear frontage being studied is very small (162 feet along Wm. O'Connell Way and 162 feet along Blossom Street). The building design alterations in the Shriners' proposal, particularly with different orientation (footprint changes) tends to increase the differences in daylight obstruction between existing and proposed.

3.2 Methodology

The daylight study was performed utilizing the Boston Redevelopment Authority Daylighting Analysis (BRADA)* computer software. In this method, a "fish eye" view of the building is taken at ground level from the centerline of the adjacent city streets; for this project, Blossom Street and Wm. Cardinal O'Connell Way. The footprint of the existing building and proposed building, as well as corners and other features are plotted onto a base map using lateral and elevation angles. The base map produced represents a picture of the building in the "sky dome" from the viewpoint chosen. The percent obstruction is then determined by width of view, the location of the viewpoint, and the building design.

Two viewpoints were chosen to evaluate daylight obstruction for the existing and proposed Shriners Burns Institute. The viewpoint locations are centered on the middle of the north and west sides of the proposed building and the centerline of the adjacent streets (Blossom Street and Wm. Cardinal O'Connell Way) (see Figure V-3.1). In the existing case, the Shriners Burns Institute lies at a 45 degree angle to the adjacent streets and to

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* Harvey Bryan and Susan Stuebing, "Boston Redevelopment Daylighting Analysis (BRADA)," MIT, Cambridge, MA.

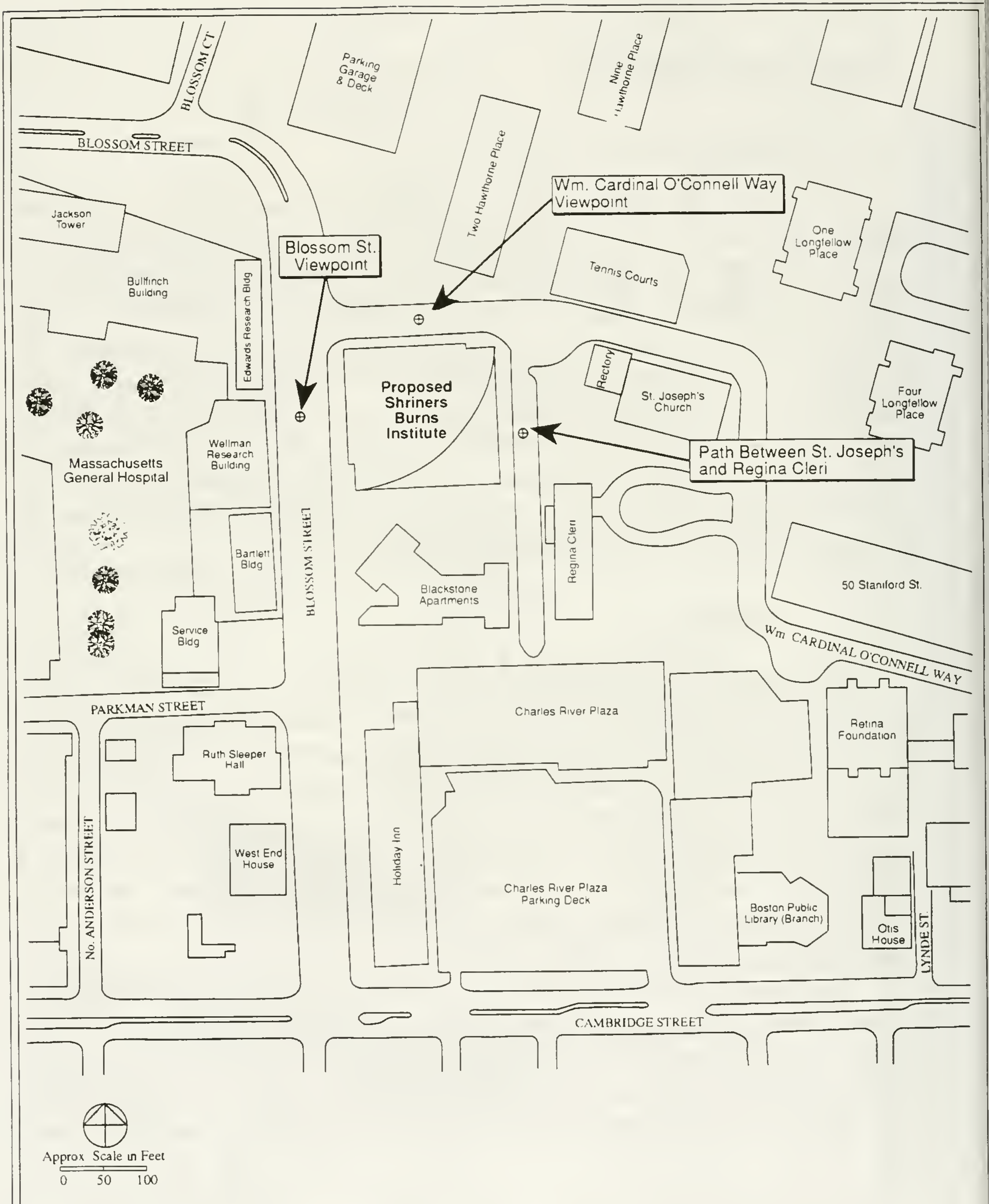

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FIGURE V-3.1
DAYLIGHT STUDY VIEWPOINT LOCATIONS
FOR THE BUILD CONDITION

the viewpoints. Since the BRADA program can only analyze block-like structures, it was, therefore, necessary to estimate the existing walls that slant away from the viewpoint as progressively wide cross-sections positioned behind each other. The narrowest cross-section facing the viewpoint was the closest to the street while the widest cross-section was the farthest from the street. Figures V-3.1 and V-3.2 illustrate the location of each viewpoint for the build and no-build conditions, respectively. Both figures indicate the width of view for each viewpoint; Figures V-3.2 A and B show the cross-sections used to estimate the dimensions of the existing hospital building.

The extent of the "sky dome" included in the analysis is determined by the width of view. The width of view, which is determined by the width of the Shriners Burns Institute property, is different for each vantage point.

A smaller width of view results in a smaller area analyzed; a larger width of view results in a larger area analyzed. In all cases examined, the angle created by the viewpoint and the edge of the width of view is less than a normal person's angle of peripheral vision. A person's vision will extend beyond the edge of the property from each viewpoint. Because the view in the analysis is cut off at the property boundary, daylight which will be experienced beyond the edge of the property is not accounted for.

3.3 Results

Table V-3.1 presents the results of the daylight analysis. Graphic illustrations of the daylight analysis are provided in Figures V-3.3 through V-3.6. The no-build condition results in the lowest obstruction value for each view. This is a result of the combined factors that the existing building is lower and that the viewpoints are located near the corners of the existing building. Under the existing condition daylight obstruction values are 18.4% at the Blossom Street viewpoint and 25.8% at the Wm. Cardinal O'Connell Way viewpoint.

Under the build condition (see Figures V-3.4 and V-3.6), daylight obstruction increases to 71.3% on Blossom Street and 79.4% on Wm. Cardinal O'Connell Way. This is primarily due to the orientation and height of the proposed building.

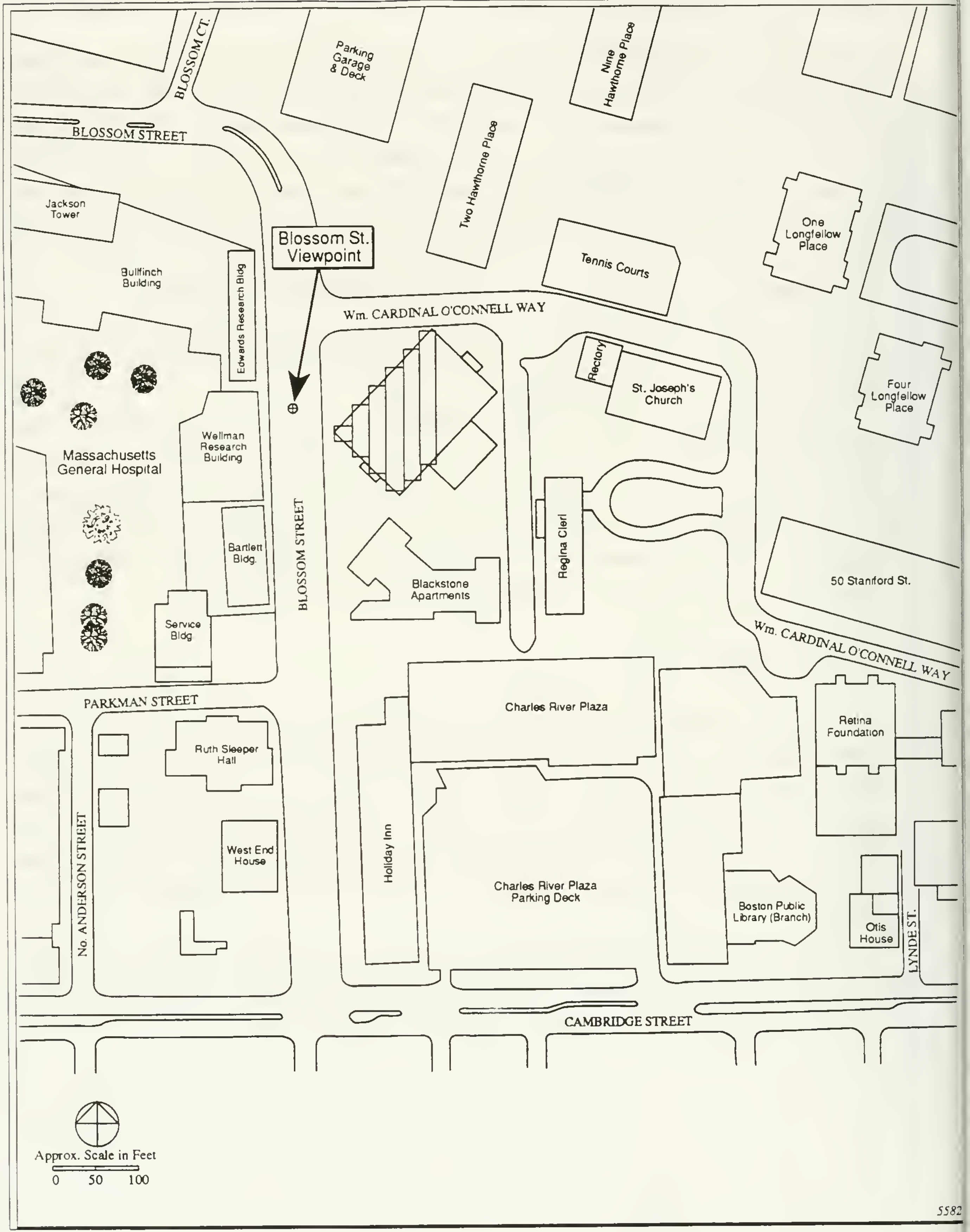

FIGURE V-3.2A
DAYLIGHT STUDY VIEWPOINT LOCATION (BLOSSOM ST.) AND THE CROSS SECTIONS EVALUATED FOR THE NO-BUILD CONDITION

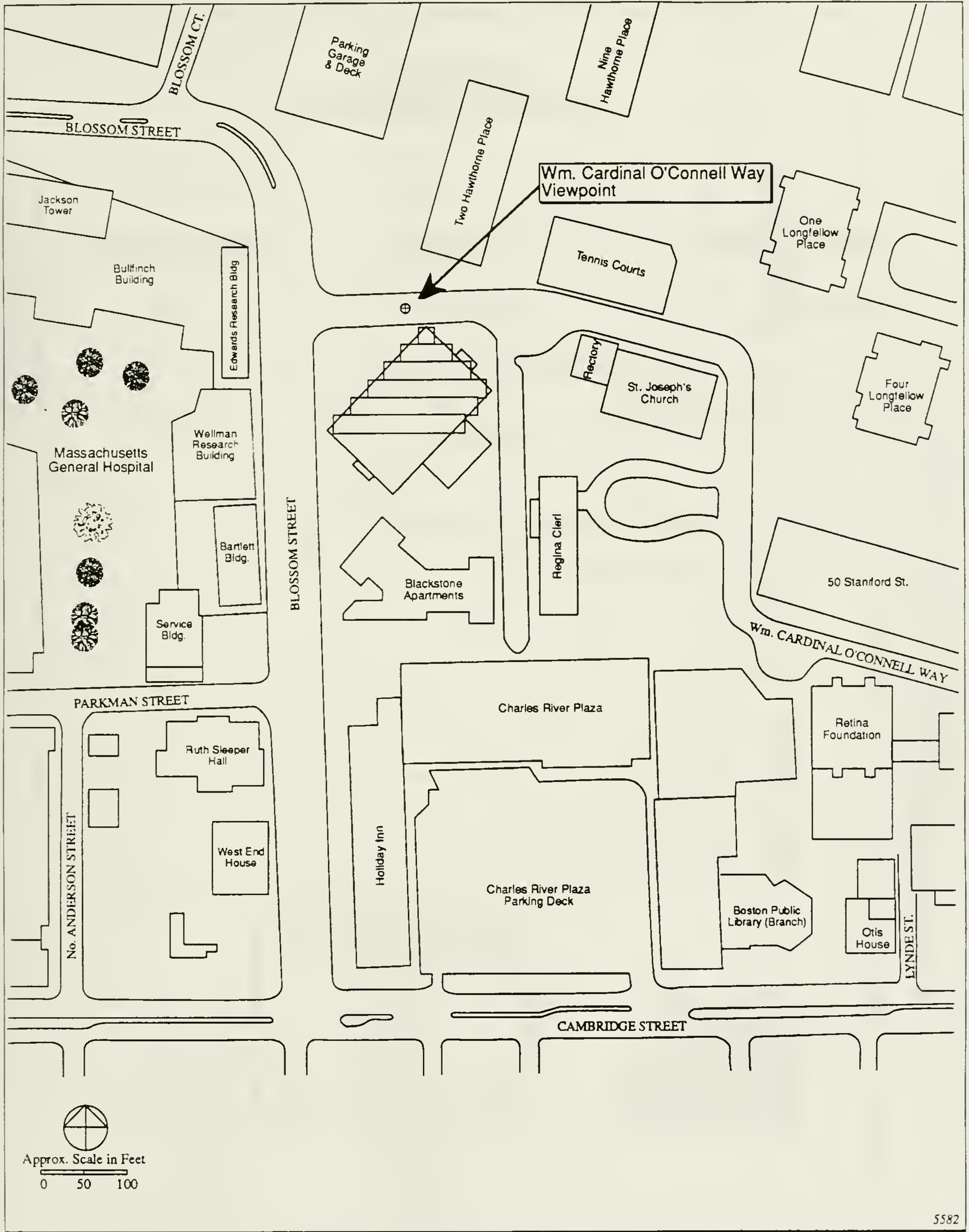

FIGURE V-3.2B
DAYLIGHT STUDY VIEWPOINT LOCATION (Wm. CARDINAL O'CONNELL WAY) AND THE CROSS SECTIONS EVALUATED FOR THE NO-BUILD CONDITION

TABLE V-3.1
DAYLIGHT OBSTRUCTION

Viewpoint Location	Alternative	Percent Obstruction
Blossom Street	No-Build	18.4
	Build	71.3
Wm. Cardinal O'Connell Way	No-Build	25.8
	Build	79.4

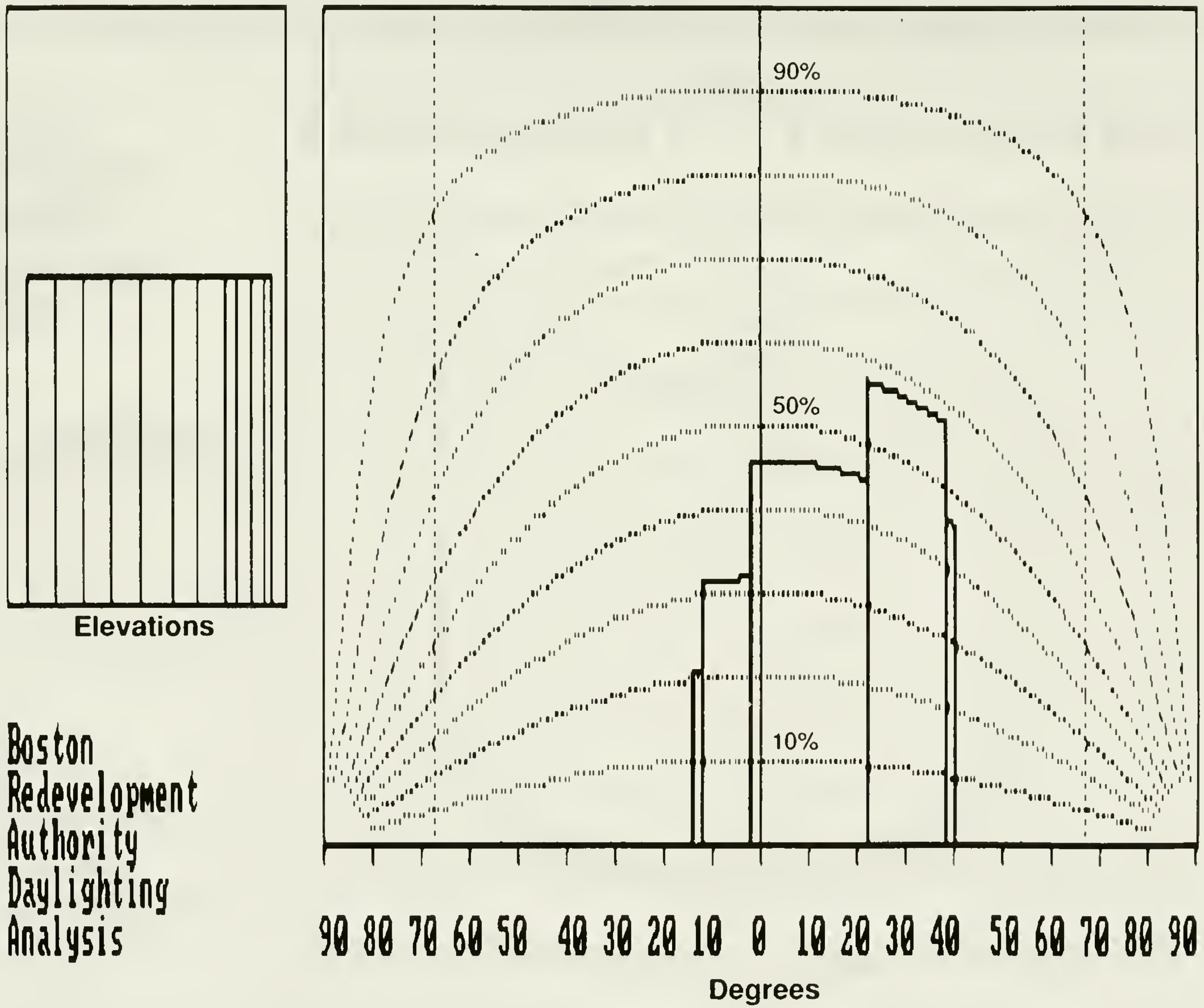

FIGURE V-3.3
DAYLIGHT OBSTRUCTION DIAGRAM FOR THE NO-BUILD CONDITION
AT THE BLOSSOM STREET VIEWPOINT

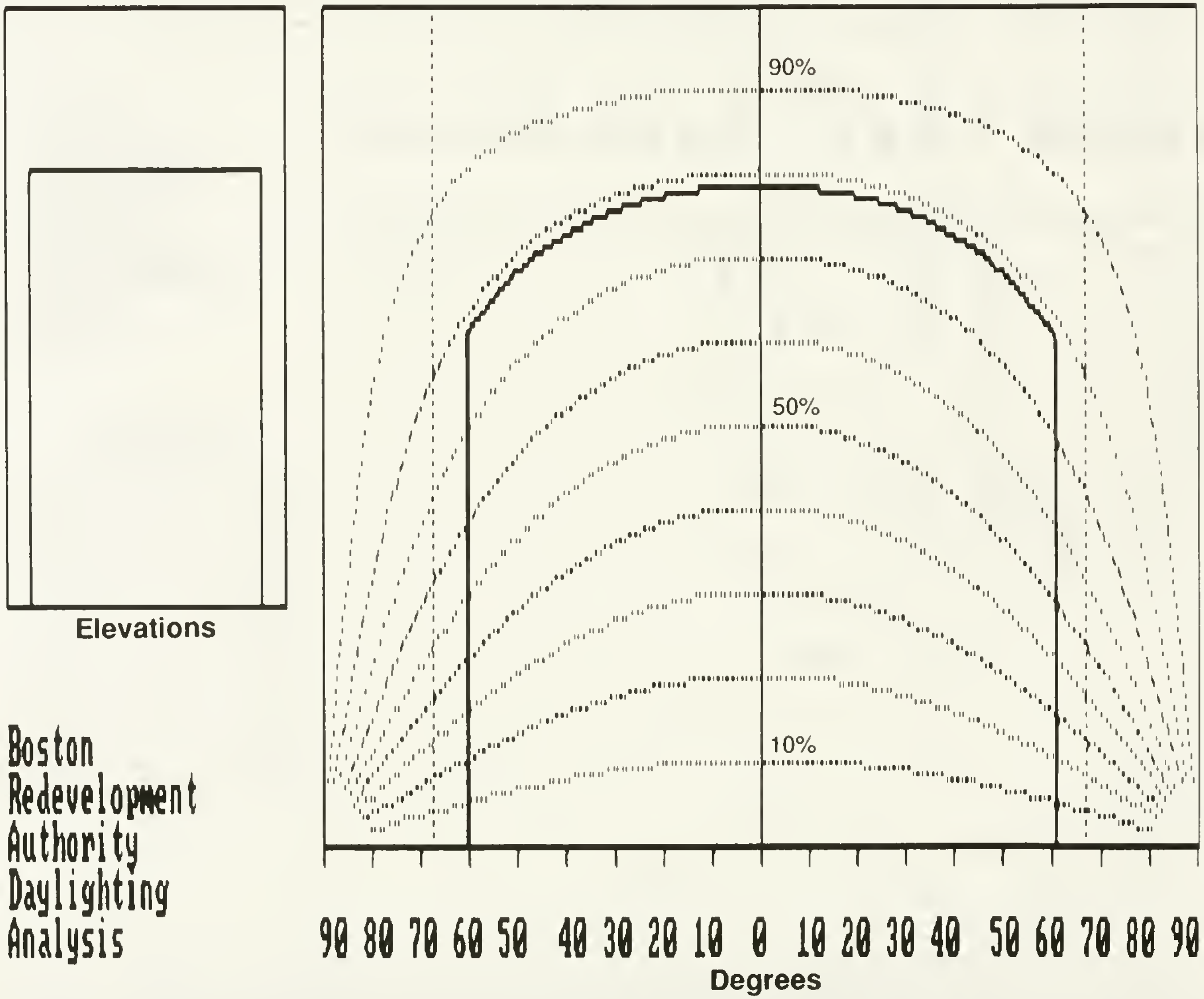

FIGURE V-3.4
DAYLIGHT OBSTRUCTION DIAGRAM FOR THE BUILD CONDITION
AT THE BLOSSOM STREET VIEWPOINT

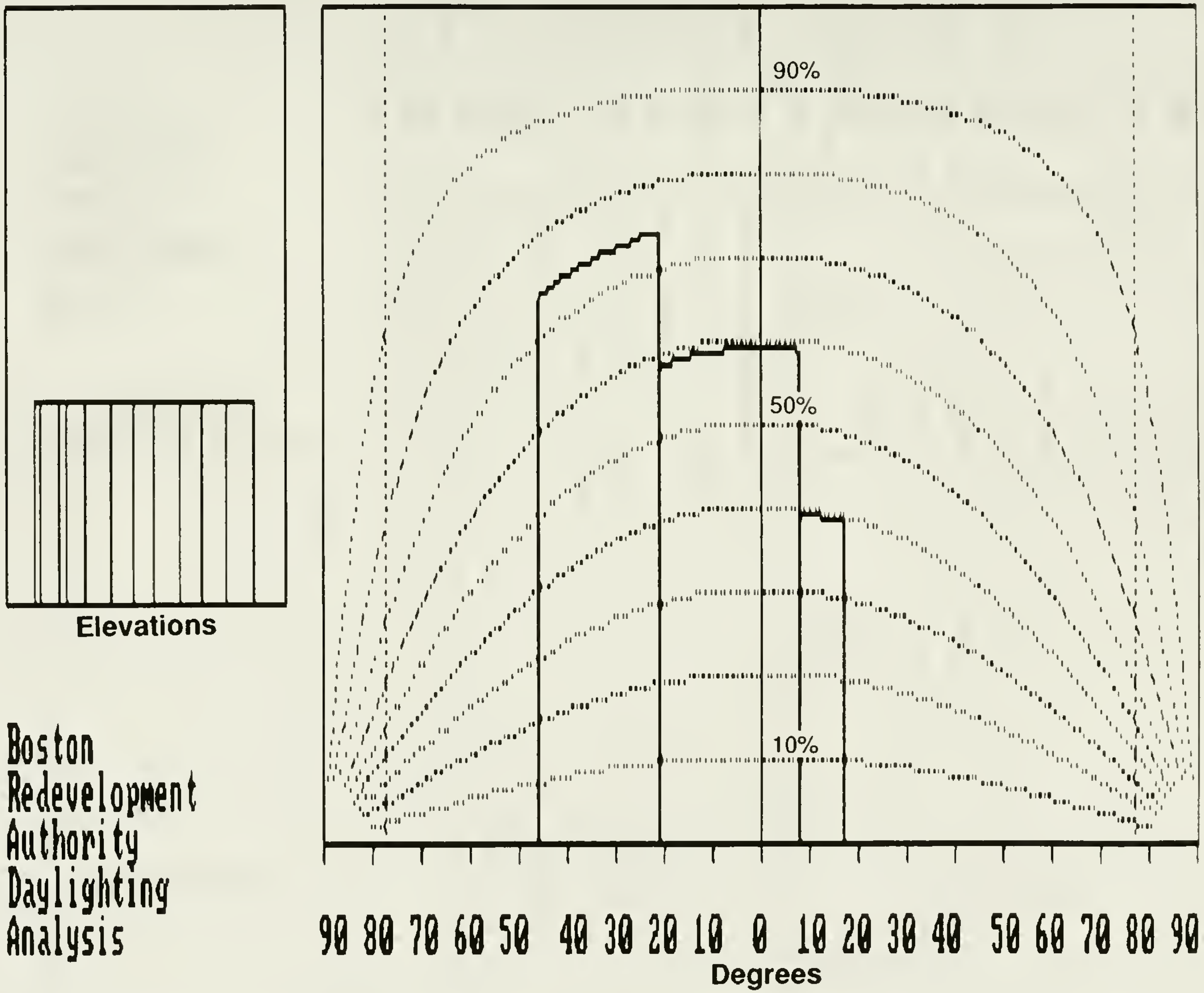

FIGURE V-3.5
DAYLIGHT OBSTRUCTION DIAGRAM FOR THE NO-BUILD CONDITION
AT THE Wm. CARDINAL O'CONNELL WAY VIEWPOINT

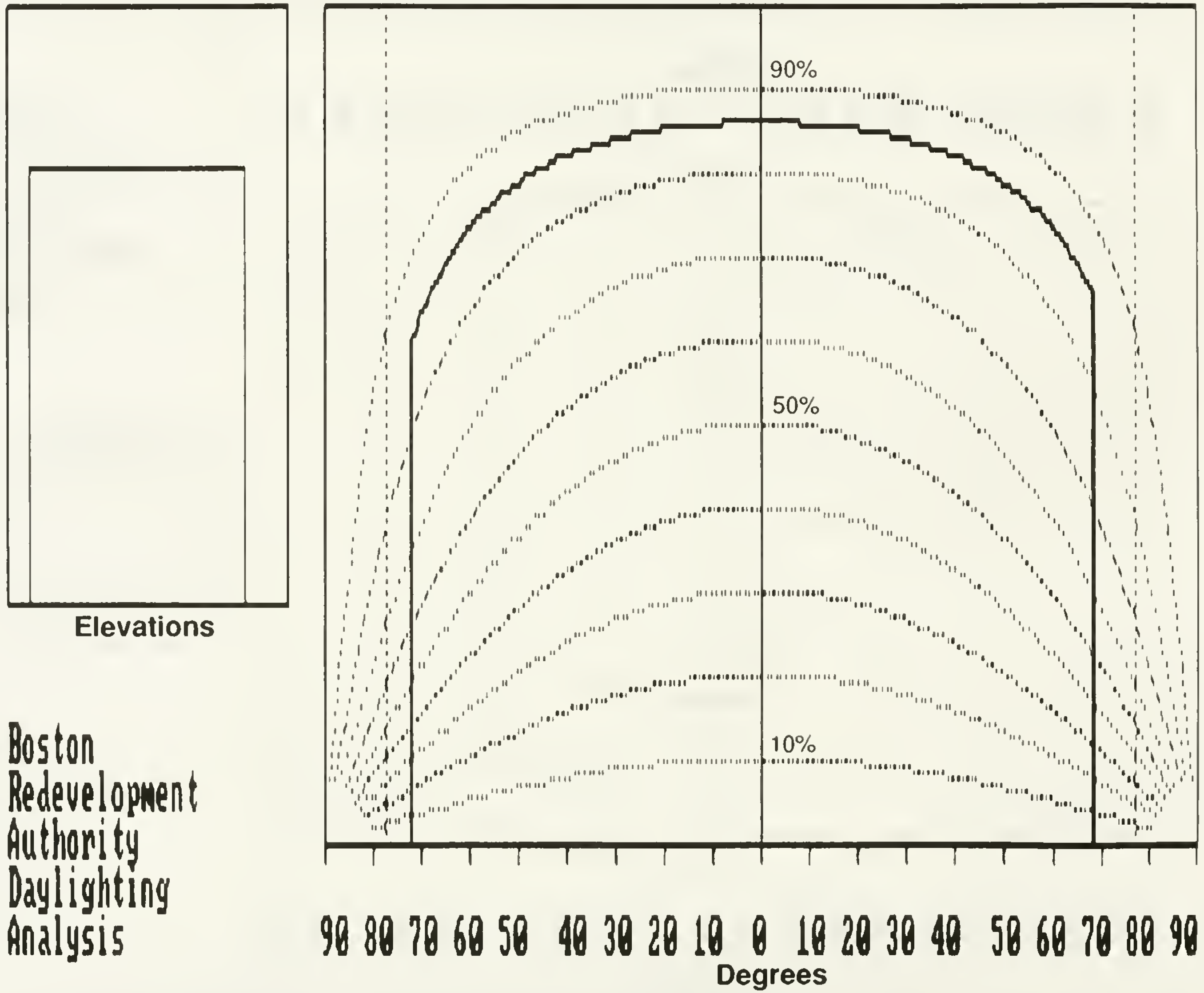

FIGURE V-3.6
DAYLIGHT OBSTRUCTION DIAGRAM FOR THE BUILD CONDITION
AT THE Wm. CARDINAL O'CONNELL WAY VIEWPOINT

3.4 Mitigation

The same design considerations affecting shadows will also help mitigate the loss of daylight along the streets surrounding the project.

3.5 Conclusions

As previously described, the daylight analysis was conducted to estimate the effect of the Shriners Burns Institute on the amount of daylight reaching the street. A daylight analysis was conducted from viewpoints centered along the proposed building at Blossom Street and Wm. Cardinal O'Connell Way. The results demonstrated an increase in daylight obstructed at these viewpoints. The increase is primarily due to a taller and reoriented building.

The daylight obstruction results are not unlike other urban areas within Boston. In addition, the conservative assumptions reflected in the viewpoint locations and limited view width tend to exaggerate the daylight obstruction findings. In all cases examined, the angle created by the viewpoint and the edges of the width of view are less than a normal person's angle of peripheral vision. A person's vision would extend beyond the edge of the property boundary from the vantage points. Since the view in this analysis is cut off at the property edge, daylight which will be experienced beyond the property edge is not accounted for. Also, as a pedestrian moves away from the worst-case viewpoints analyzed, along the building, the amount of daylight obscured by the building will lessen as the viewer's perception of the sky dome is less dominated by the building.

4.0 SOLAR GLARE ANALYSIS

4.1 Introduction

The design of the proposed Shriners Burns Institute includes a curved, glass facade on its southeast side. This facade will consist of patterned glass which is a clear glass treated with a ceramic coating (in a dot or line pattern) to limit the transmission of sunlight into the building. The project will use the patterned glass in contrast to the use of mirror coated, highly reflective glass, found on other large urban projects, to minimize solar heating. The glass will serve to mitigate potential solar glare from the southeast facade by reducing the intensity of the sunlight that is reflected. For example, the proposed patterned glass reflects approximately 15 to 25% percent (depending on the extent of ceramic coating) of incoming sunlight as opposed to mirror coated glass which reflects approximately 35 percent of incoming sunlight. The vertical pattern (from bottom to top) will be as follows: (1) 2 feet of metal panel, (2) 4 feet 4 inches of clear glass (15% reflectance), (3) 2 feet 2 inches of clear glass with 25% of the surface area coated with the ceramic material (17.5% reflectance), (4) 2 feet 2 inches with 50% coated clear glass (20% reflectance), and (5) at the top of each window, 4 feet 4 inches of completely coated glass (25% reflectance). Thus, the intensity of reflected light from the building will also be broken up in the vertical direction. (Note that the reflectances provided above are for a white ceramic coating. The color of the ceramic coating has not been presently selected. If a darker color is selected, reflectance will be less.)

Experience shows that reflected sunlight, or solar glare as it is generally referred to, may be a nuisance, and can produce visual impairment at times or even discomfort if the source is very intense. Because the project's design does not include highly reflective glass, the effects of solar glare (i.e., the intensity) are mitigated. An analysis of potential glare is provided, however, because some reflection will still occur.

The sun's intensity or brightness, the ability of a surface to reflect light and the sun's altitude angle are the factors affecting potential visual impairment from solar glare. Two general types of surfaces can be distinguished: (1) those which are "smooth specular (flat) surfaces which reflect the sun's rays in a parallel fashion"; and (2) those which scatter or diffuse the sun's rays in various directions, such as porous or curved surfaces.[1] Smooth specular surfaces which reflect the sun's rays in parallel fashion produce an image of the source (spot glare) at an intensity of that equal to that of the sun times the surface's reflectivity. Other surfaces which are porous will scatter or diffuse the sun's rays (scattered glare). These surfaces will appear brighter, but they will actually have a lower intensity than if the surface were non-porous. For the proposed Shriners Burns Institute, the curve of the project's southeast facade will have the tendency to diffuse incoming, parallel solar rays which are reflected, by reflecting the rays away from each other in a fan-like pattern. Thus potential spot glare will be reduced. The curved surface when examined close up, however, will consist of narrow flat glass surfaces each progressively placed at an angle to each other to produce the overall curved surface. Therefore, for a particular sun angle and observer, even though the overall curve will have the tendency to diffuse sunlight, a single flat section (6.5 feet wide) of vertical glass may produce a narrow band of reflected light.

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[1] Erickson, Donald K., "Seattle - Coping with Visual Impacts, Evaluation of Light and Glare," EC, July, 1980.

Studies indicate that solar glare should be evaluated for the events when reflective light is visible within the normal human viewing range. The normal human viewing range is defined as an angle 30 degrees above the horizontal, 45 degrees below the horizontal, and 65 degrees to the right or left of the forward line of sight.[1] Therefore, reflected sunlight could be found to occur within the normal human viewing range when the sun's altitude angle is 30 degrees or less above the horizon and the reflected sunlight is "65 degrees to the right or left from a forward line of site."[1] Since lower solar altitude angles produce glare that is within the normal viewing range, the sun's rays will also pass through more atmosphere than at higher angles thus scattering incoming rays more (see Appendix B for illustrations of the approach).

The study below provides an evaluation of reflected sunlight onto local street and pedestrian levels from the project's curved, glass southeast facade.

4.2 Methodology

Potential for solar glare, and primarily spot glare, from the project's southeast facade was evaluated using solar altitude and azimuth angles and simple geometry. This was conducted by considering the location of reflected light during four times of year; spring and autumnal equinox and winter and summer solstice. Initially, three hours for each of these four cases were selected; 8:00 AM, noon, and 4:00 PM. These times were chosen because both pedestrians during lunch (noon) and commuters (8:00 AM and 4:00 PM) are effected by solar glare. For each of these times, solar angle data was calculated. Altitude and azimuth angles are presented in Table V-4.1 for each of the time periods evaluated.

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[1] Erickson, op. cit.

TABLE V-4.1
ALTITUDE AND AZIMUTH ANGLES

Time		Altitude Angle (Degrees) Above Horizon	Azimuth Angle (Degrees) Clockwise from North
Spring Equinox March 21	- 8:00 AM EST*	24	114
	- Noon EST	48 +	186
	- 4:00 PM EST	19	252
Summer Solstice June 21	- 8:00 AM EDT**	29	84
	- Noon EDT	69 +	151
	- 4:00 PM EDT	46 +	261
	- 6:00 PM EDT	23	281
Autumn Equinox September 21	- 8:00 AM EDT	14	103
	- Noon EDT	47 +	164
	- 4:00 PM EDT	29	240
Winter Solstice December 21	- 8:00 AM EST	6	130
	- Noon EST	24	184
	- 4:00 PM EST	2	236

+ Reflected sunlight will be outside normal viewing range.

* Eastern Standard Time

** Eastern Daylight Time

Because reflected sunlight is only in the normal viewing range when the sun's altitude angle is below 30 degrees, cases with larger angles were not included in this study. The summer afternoon case, 4:00 PM EDT, was therefore not considered. The first afternoon hour that the sun altitude angle was below 30 degrees was calculated (6:00 PM EDT - 23 degrees) and evaluated in this study.

Since light is reflected off a specular surface at the same angle the light strikes the surface (measured from an imaginary line perpendicular to the surface), the light's angle of reflectance can be determined if its angle of incidence is known. In the horizontal plane, the angle of incidence was determined by knowing the sun's azimuth angle and the orientation of the reflective surface. By projecting the sun's rays from the corners of the building facing the sunlight, the area potentially affected by solar glare was determined. The distance that the reflected sunlight will extend was determined by projecting the sun's rays, using the appropriate altitude angle, from the top of the reflective surface (133 feet). The reflected ray was then extended until it intersected ground level.

In some cases, reflected light will be intercepted by adjacent buildings. The reflected light can either be completely blocked by a building or partially intercepted. In the case where reflected light is intercepted by a lower nearby building, only the upper portion of reflected light remains unopposed. This results in a shaded area just beyond the adjacent building followed by a resumption of the glare sector further away. Adjacent buildings will also act to block out incoming rays and thus reduce the amount of sunlight actually striking the reflective surface. The results presented in this study are conservative in that they do not take into account the effect of the blocking of incoming rays by nearby buildings.

Using sun position data, diagrams of reflected sunlight from the project were developed for each study case that the reflected light was predicted to be in the normal viewing range. The solar glare diagrams are shown in Figures V-4.1 through V-4.8. Because the southeast facade is curved and diffuses reflected sun rays, arrows are shown to depict how representative points on the southeast facade produce narrow bands of spot glare (from narrow sections of flat glass which make up the curved surface) at pedestrian and street level locations. The north and west building surfaces will consist of more typical construction materials such as masonry or stone and clear/tinted glass. Therefore, these surfaces are not considered an important source of solar glare. However, some qualitative discussion of the sunlight reflected from these surfaces will also be presented in the following results section.

4.3 Results

Since the southeast surface of the proposed Shriners Burns Institute building is curved, it will scatter the sun's rays in a number of directions, thereby diffusing the reflected light. As discussed earlier, spot glare will also be mitigated through the use of glass treated with a ceramic coating pattern instead of a mirror-like coating and the narrow width of individual flat glass panels which make up the curved surface.

Areas affected by these narrow bands of reflected light will be primarily to the south and east of the hospital. These impacts, as well as those anticipated on the nearby roads are discussed in detail below for each of the periods evaluated.

4.3.1 Winter Solstice

The winter period is of most concern for solar glare because the winter sun altitude angle is continuously below 30 degrees. On the winter solstice (December 21) at 8:00 AM EST, the sun is very low and is positioned in the southeast portion of the sky. A schematic diagram showing areas where narrow bands of reflected light may be evident is shown in Figure V-4.1. The incoming solar rays strike the center of the curved reflective surface at very close to a normal (perpendicular) orientation and are, therefore, reflected almost directly back in the same direction. Because of the curve of the surface, the incoming rays strike the edges of the building at an orientation close to 45 degrees and, therefore, reflect off the building at approximately 45 degrees. The low solar altitude angle will result in the sunlight being reflected a relatively long distance (1,186 feet). In this case, potential glare will extend off the figure page which is represented by the double arrow.

Reflected light will be intercepted by several nearby buildings including the Blackstone and Regina Cleri residential buildings and the St. Joseph's Church. During this winter morning period, the structures will partially intercept reflected sunlight creating building shadows within the solar glare area and will therefore lessen the amount of area impacted.

Small sectors of reflected light will extend across Blossom Street and Wm. Cardinal O'Connell Way. Sectors of spot glare may also cross Cambridge Street, but at angles near the edge of the 65 degree viewing range; therefore, little interference with motor vehicles is expected along this roadway. Furthermore, no solar glare is noted at either the Blossom/Cambridge or Blossom/Wm. Cardinal O'Connell intersections.

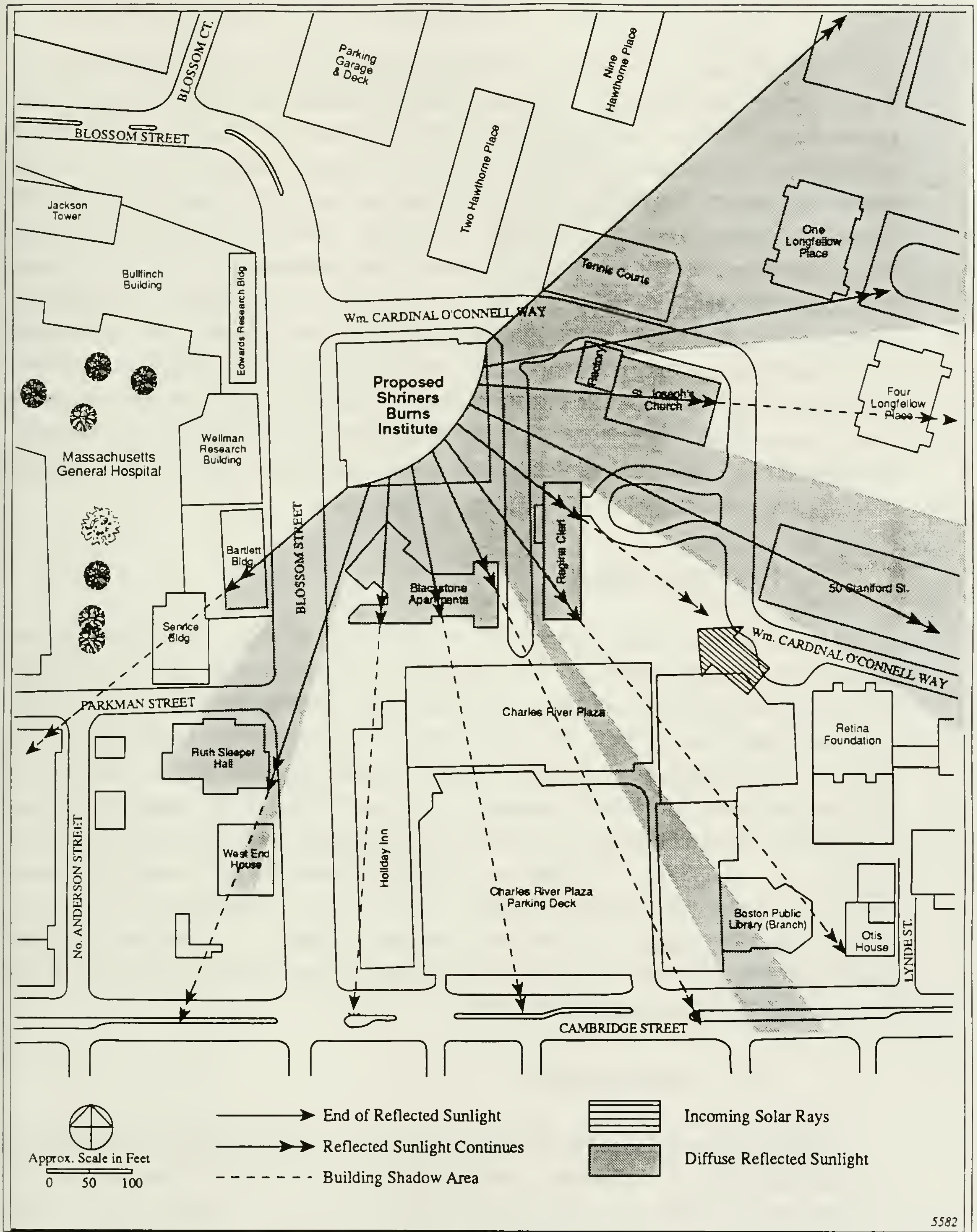

FIGURE V-4.1
REFLECTED SUNLIGHT PATTERN DIAGRAM FOR THE
WINTER SOLSTICE 8 AM EST TIME PERIOD

At 12:00 noon, on the same day (Figure V-4.2), the sun's rays will come from the south at a higher altitude angle. The higher angle of incidence will result in sunlight being reflected only 297 feet. During this period, the Blackstone and Regina Cleri residential buildings and the St. Joseph's Church will act to completely intercept the reflected light directed at them. Of the nearby roads, only a small section of the northern portion of Wm. Cardinal O'Connell Way will be affected by sunlight. Finally, at 4:00 PM EST (Figure V-4.3), incoming solar rays are virtually parallel to the southwest section of the reflective glass surface resulting in a minimal range of potential solar glare impacts. Sunlight that does reach the glass surface and is not intercepted by a nearby building will be reflected off a long distance (4,481 feet) due to the low solar altitude angle. During this period, solar rays will also reflect off the western side of the Shriners Burns Institute towards the row of Massachusetts General Hospital (MGH) buildings on Blossom Street. However, since the western side of the hospital building does not consist of entirely glass or highly reflective glass, the reflected light is expected to be minimal.

4.3.2 Spring Equinox

On the spring equinox (March 21) at 8:00 AM EST, Figure V-4.4 indicates that reflected light will be oriented much like the winter morning period. The curved surface will reflect and diffuse the sunlight in a similar fan-like pattern since the incoming solar rays are roughly coming from the same direction. During this spring morning period, however, the solar altitude angle is higher, which shortens the glare affected area length to 293 feet. Reflected light will be blocked by the three buildings to the south and east and road impacts will be restricted to small sectors extending onto Blossom Street and Wm. Cardinal O'Connell Way. At 12:00 noon EST on the same day, reflected light is noted beyond the normal viewing range because of the sun's high altitude angle (>30 degrees). At 4:00 PM EST (Figure V-4.5) affected areas will consist of a narrow sector of short length (388 feet long) that will glance off of the west portion of the southeast facade and will not reach Wm. Cardinal O'Connell Way.

4.3.3 Summer Solstice

During the summer solstice (June 21), Figure V-4.6 indicates that at 8:00 AM EDT the solar rays strike the southeast surface from an easterly direction. The relatively high altitude angle will make the extent of reflected light in the normal viewing range relatively

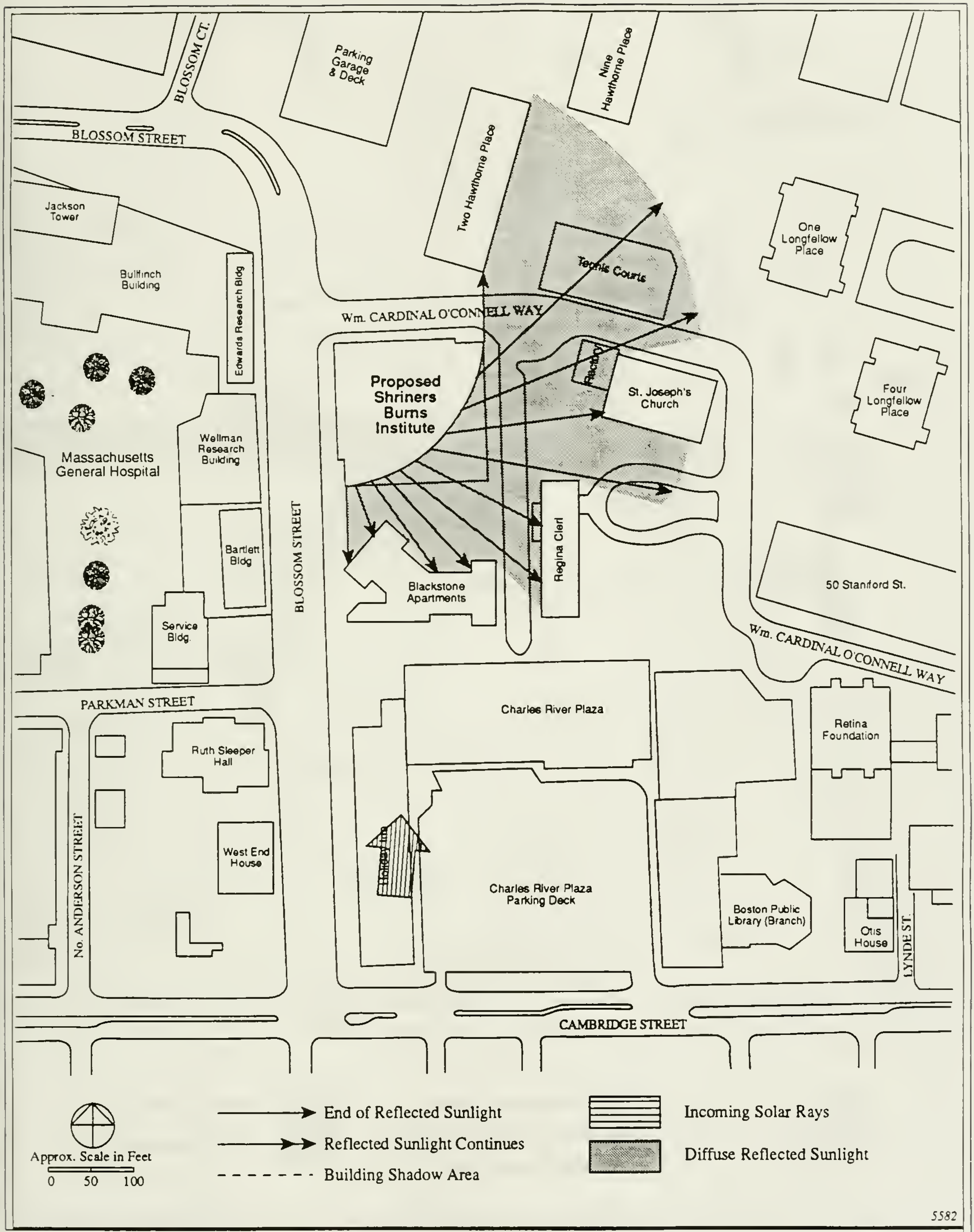

FIGURE V-4.2
REFLECTED SUNLIGHT PATTERN DIAGRAM FOR THE
WINTER SOLSTICE 12 NOON EST TIME PERIOD

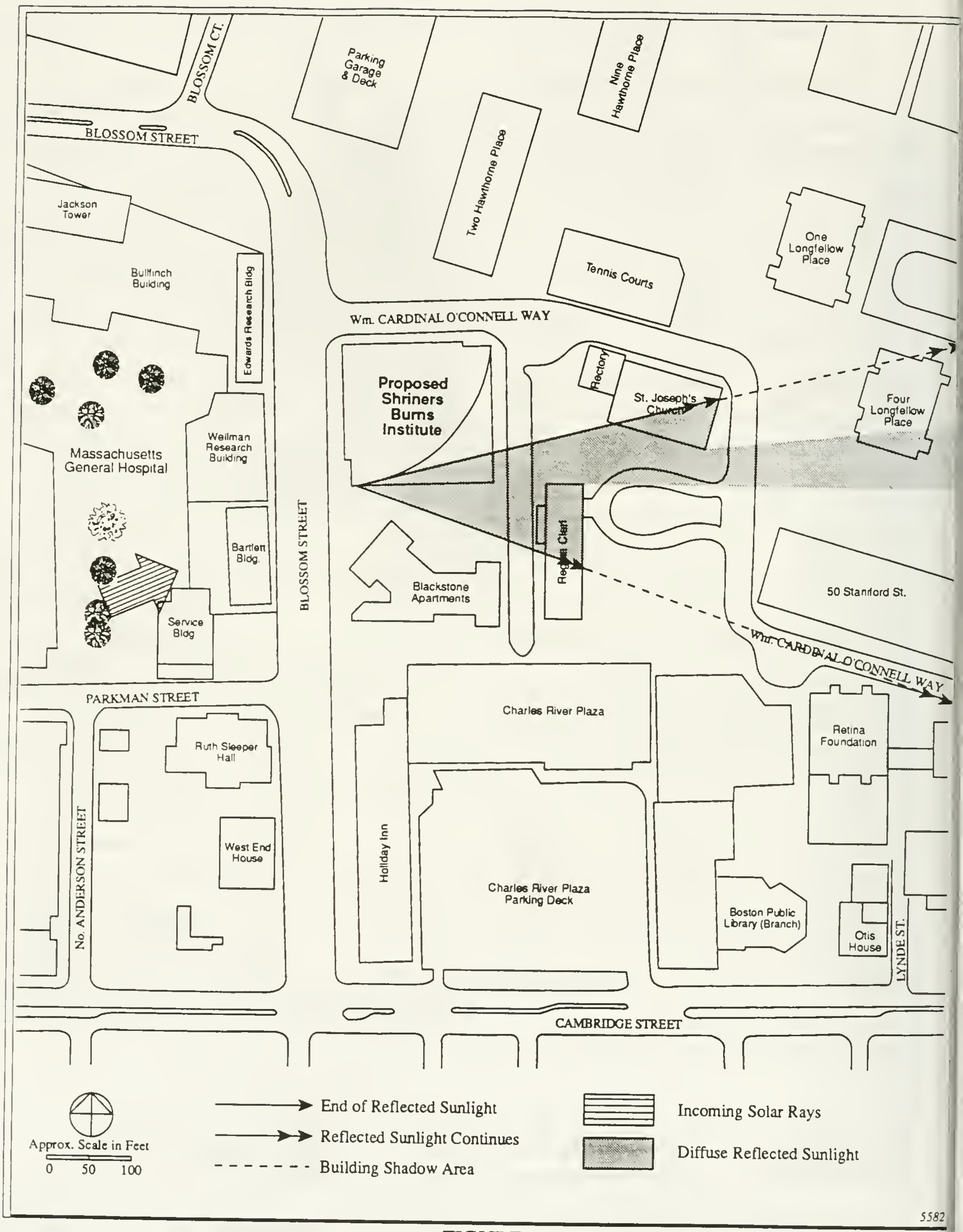

FIGURE V-4.3
REFLECTED SUNLIGHT PATTERN DIAGRAM FOR THE
WINTER SOLSTICE 4 PM EST TIME PERIOD

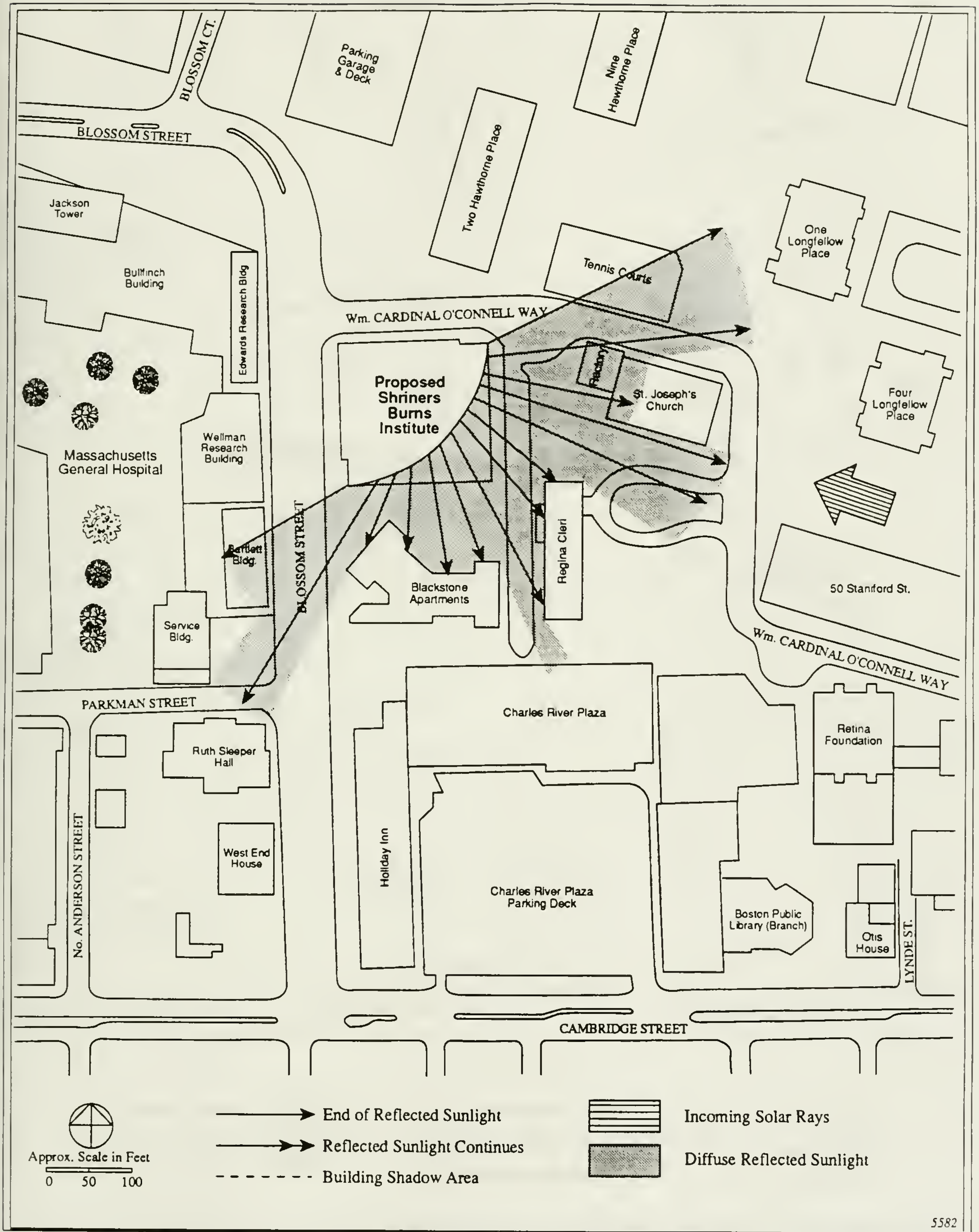

FIGURE V-4.4
REFLECTED SUNLIGHT PATTERN DIAGRAM FOR THE SPRING EQUINOX 8 AM EST TIME PERIOD

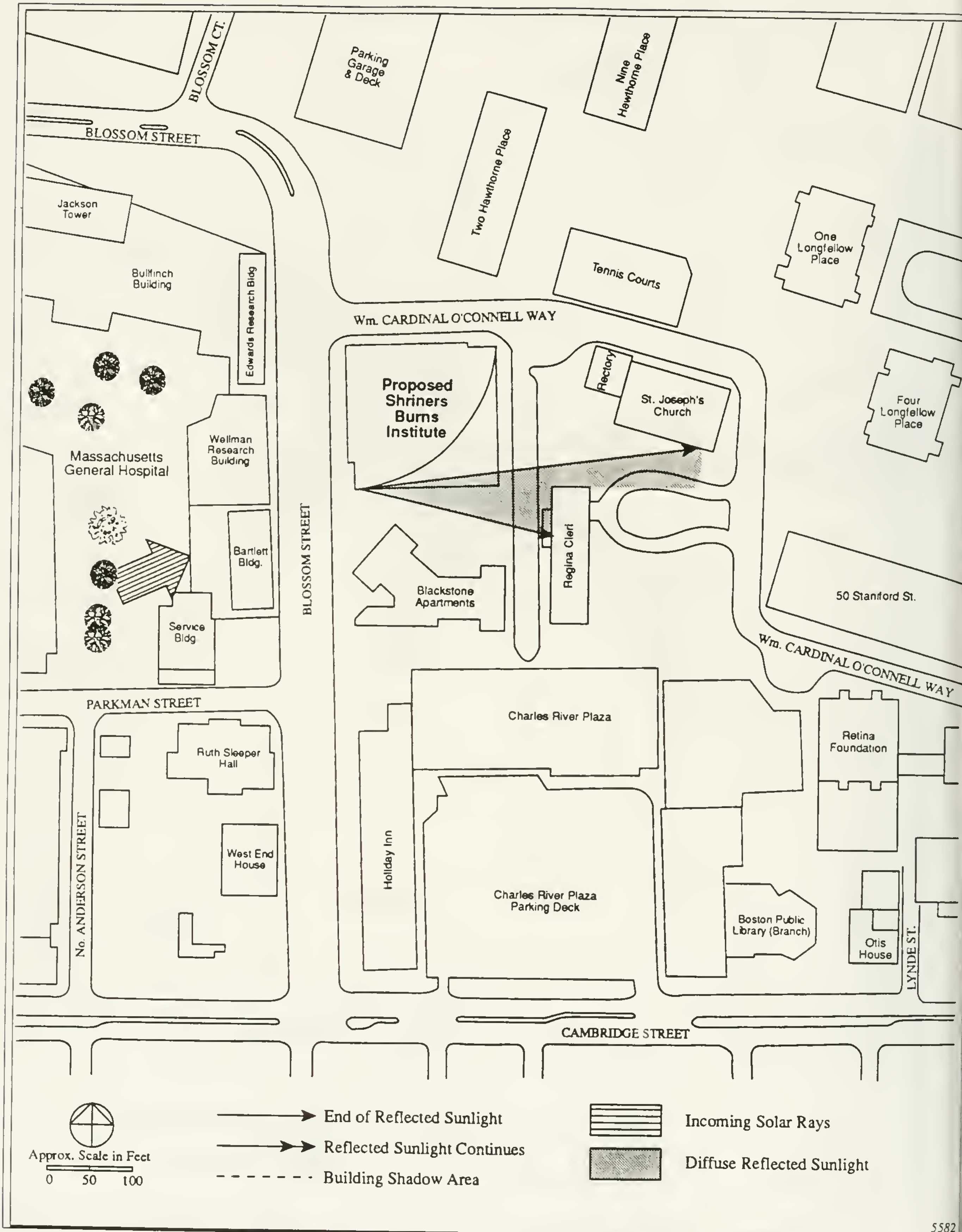

FIGURE V-4.5
REFLECTED SUNLIGHT PATTERN DIAGRAM FOR THE SPRING EQUINOX 4 PM EST TIME PERIOD

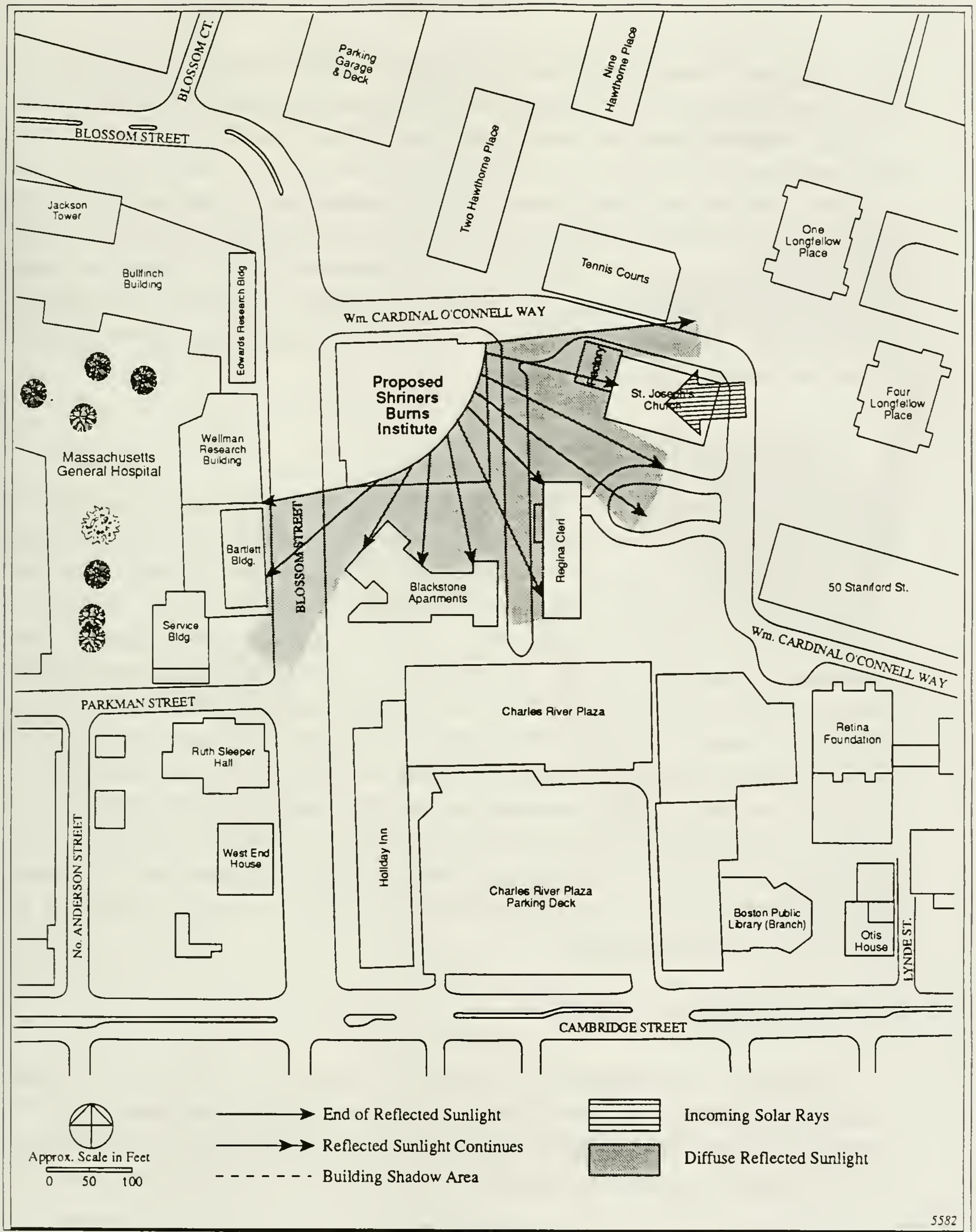

FIGURE V-4.6
REFLECTED SUNLIGHT PATTERN DIAGRAM FOR THE
SUMMER SOLSTICE 8 AM EDT TIME PERIOD

short at 238 feet. Reflected light will be blocked by the three buildings to the south and east of the hospital and by the Bartlett Hall building at Massachusetts General Hospital (MGH). Potential impacts on roadways are restricted to a small sector extending onto Blossom Street just southwest of the project and onto Wm. Cardinal O'Connell Way northeast of the project. These impacts, however, fall well short of any intersections. At 12:00 Noon EDT reflected light is beyond the normal viewing range because of the high solar altitude angle. At 6:00 PM EDT (the first afternoon hour with an altitude angle below 30 degrees) the incoming solar rays from the west will not strike the southeast facade. During this period, lower intensity glare will be reflected from single windows on the west and north surfaces of the hospital.

4.3.4 Autumnal Equinox

For the autumnal equinox (September 21), Figure V-4.7 indicates that at 8:00 AM EDT the solar rays from an east-southeasterly direction are reflected off the southeast surface to a distance of 537 feet. The Blackstone and Regina Cleri buildings act to block out reflected light along with Ruth Sleeper Hall and the West End House. At the same time, St. Joseph's Church and Bartlett Hall will partially intercept reflected light as shown, but because of their lower heights, reflected light in the normal viewing range resumes beyond the extent of the shadows cast by the buildings. Again, the roadways that may be affected by narrow bands of reflected light are Blossom Street and Wm. Cardinal O'Connell Way. However, these sectors are away from any intersections. At 12:00 Noon EDT, reflected light is outside the normal viewing range because the solar altitude angle is too high. At 4:00 PM EDT (Figure V-4.8) the solar rays will come from the southwest and only a small section of the southeast surface will be hit by the incoming rays to a distance of 240 feet. There will be some lower intensity reflection from single windows on the hospital's western building surface.

4.4 Mitigation

Solar glare impacts from the new building are expected to be minor. The building materials will include a number of design features to mitigate these effects. First, the project will not use mirror coated, highly reflective glass which is generally found to cause the most intense occurrences of spot glare. Instead, the project will use clear glass with a

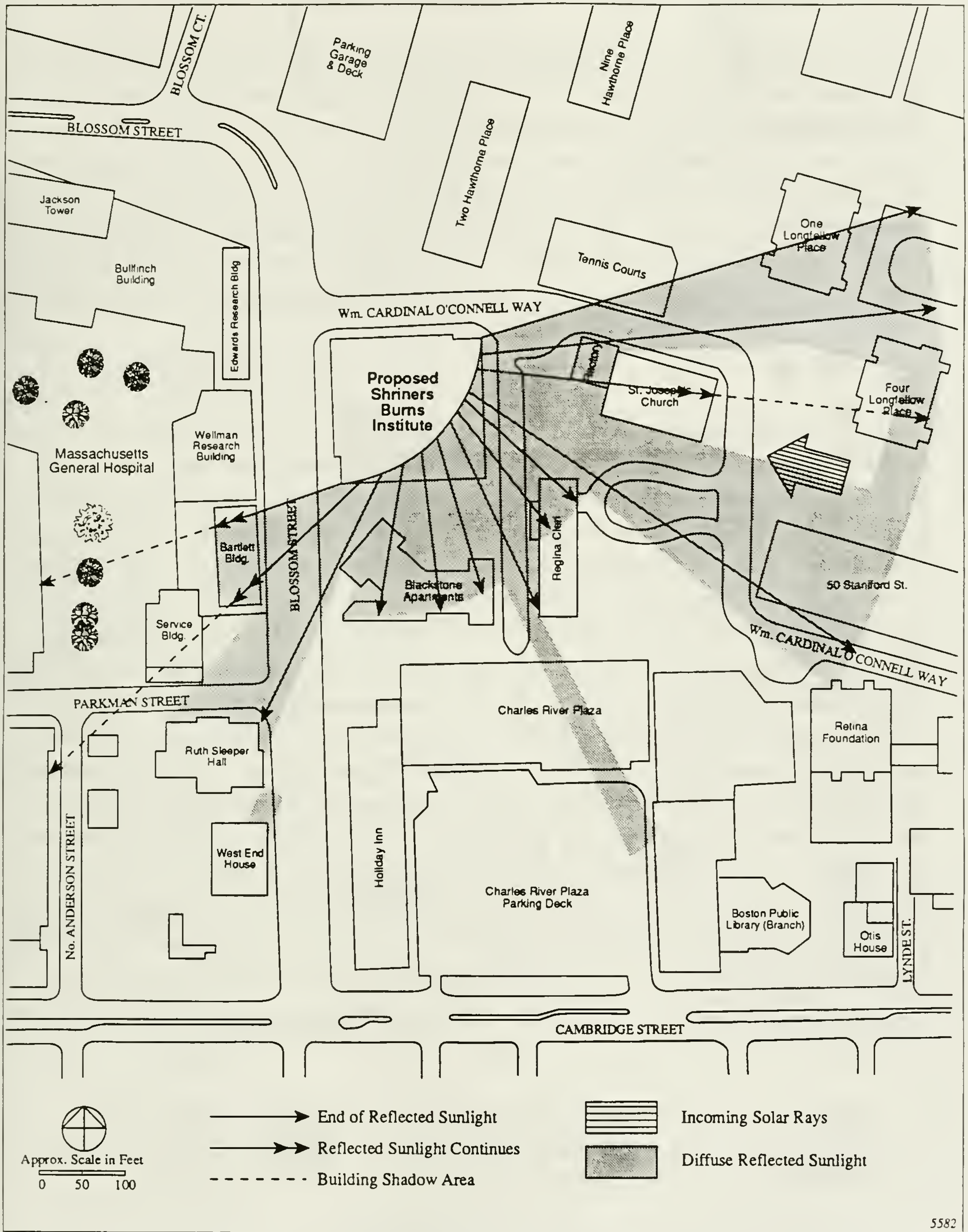

FIGURE V-4.7
REFLECTED SUNLIGHT PATTERN DIAGRAM FOR THE AUTUMNAL EQUINOX 8 AM EDT TIME PERIOD

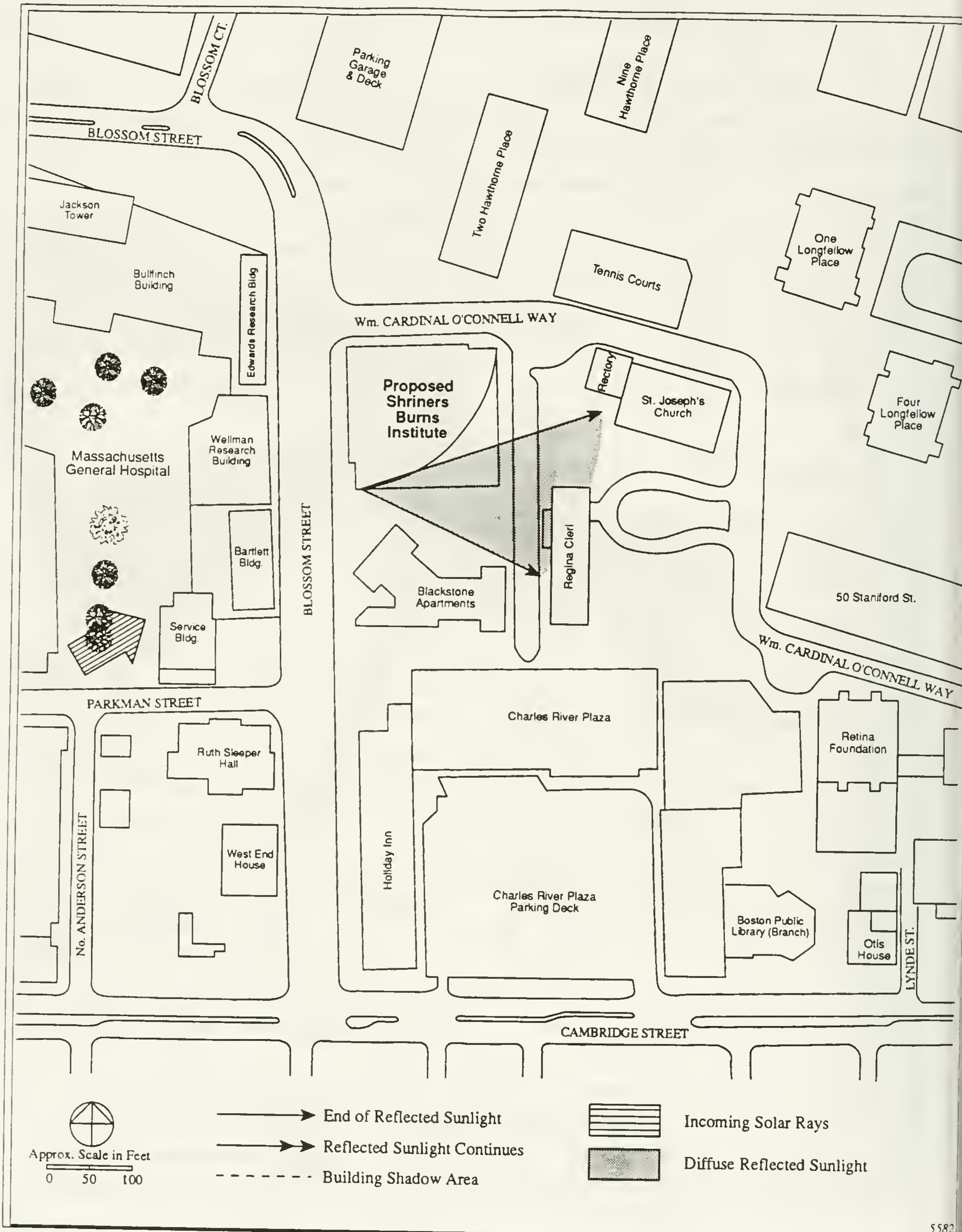

FIGURE V-4.8
REFLECTED SUNLIGHT PATTERN DIAGRAM FOR THE AUTUMNAL EQUINOX 4 PM EDT TIME PERIOD

ceramic coating to limit the transmission of sunlight into the project building and reduce the intensity of reflected light. Also, the curve of the southeast facade will mitigate the effects of reflected light by scattering incoming parallel rays of sunlight. The flat windows making up the curved surface will produce some reflected light, however, but the reflected light will consist only of narrow bands the width of the individual flat sections (about six and a half feet). Although it may appear that reflected light is spread widely by the curved surface, the curved surface actually tends to minimize the width of perceived reflected light visible from any one location.

4.5 Conclusion

The analyses demonstrate that the spread of potential reflected light will generally be limited to the area southeast of the project; i.e., north of Cambridge Street, east of Blossom Street, and south of Wm. Cardinal O'Connell Way. In addition, these effects will primarily be noticeable during only the early morning hours. The project's southeast facade will be the major contributor of reflected light, however, it will include a number of design features to mitigate these effects. First, the project will not use mirror coated, highly reflective glass which is generally found to cause the most intense occurrences of spot glare. Instead the project will use clear glass with a ceramic coating to limit the transmission of sunlight into the project building and reduce the intensity of reflected light. Also, the curve of the southeast facade will mitigate the effects of reflected light by scattering incoming parallel rays of sunlight. The flat windows making up the curved surface will produce some reflected light, however, but the reflected light will consist only of narrow bands the width of the individual flat sections (about six and a half feet. Although it may appear that reflected light is spread widely by the curved surface, the curved surface actually tends to minimize the width of perceived reflected light visible from any one location. In addition, the study indicated that there would not be any spot glare within the direct line of vision of any major roadway or at any roadway intersection.

5.0 AIR QUALITY ANALYSIS

5.1 Introduction

An air quality modeling analysis was conducted for the Cambridge Street/Staniford Street intersection to address possible impacts from the proposed Shriners Burns Institute project-generated traffic. The Cambridge Street/Staniford Street intersection is the only signalized intersection meeting the BRA and DEP criteria for air quality analysis (i.e., LOS D with 10% project-related growth or LOS E or F). The Cambridge Street/Staniford Street intersection operates at LOS F for the peak one-hour case in the existing, and future no-build and build conditions. Impacts of the proposed garage ventilation system were also evaluated.

5.2 Objective

The objective of the air quality analysis is to determine whether, construction of the proposed Shriners Burns Institute will cause or increase any predicted exceedance of the Massachusetts and National Ambient Air Quality Standards (NAAQS) for carbon monoxide (CO). CO is used in this analysis as an indicator of roadway air pollution levels, since it is the most abundant pollutant emitted by motor vehicles.

NAAQS for carbon monoxide have been set by the U.S. Environmental Protection Agency (EPA). Standards for the Commonwealth of Massachusetts are identical to the Federal standards. The primary CO standards, designed to protect the public health, set a maximum concentration of 35 parts per million (ppm) for a one-hour period, and 9 ppm for eight hours, each not to be exceeded more than once per year.

Using air quality modeling techniques, CO levels are estimated at identified areas of human activity (sensitive receptors) with and without the proposed project. Projected pollutants levels, including background air quality, are then compared to the NAAQS. The air quality analysis is based on a modeling protocol approved by the Department of Environmental Protection (DEP)* and BRA**.

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* Approval letter from Mr. Jon Andersen, Environmental Review Officer, Department of Environmental Protection, September 9, 1991.

** Approval letter from Mr. Richard Mertens, Environmental Review Officer, Boston Redevelopment Authority, September 6, 1991.

5.3 Background Air Quality

An air quality analysis requires an estimate of "background" air quality levels. Background levels reflect the contribution of all sources in the project area, less the specific intersections and garage analyzed. For analysis purposes, background CO levels in the project area were determined by the DEP as 5.0 ppm and 3.0 ppm, for the peak one-hour and eight hour periods, respectively. These values are also used for future years in the analysis.

5.4 Intersection Analysis

5.4.1 Methodology

The Shriners Burns Institute air quality analysis is based on DEP recommended procedures. The analysis calculates maximum one-hour and eight-hour CO concentrations at four sensitive receptors, located adjacent to the Cambridge Street/Staniford Street intersection for the existing (1991), no-build (1994), and build (1994) cases.

Consistent with EPA Guidelines,* receptor locations were situated where maximum carbon monoxide concentrations are likely to occur (i.e., adjacent to intersection vehicle queues), and where the general public is likely to have access. The intersection geometry and receptor locations for the Cambridge Street/Staniford Street intersection are shown in Figure V-5.1.

For each case, the EPA MOBILE4** and CAL3QHC*** computer programs are used to calculate motor vehicle emissions and CO concentrations at intersections. Emissions data calculated by the MOBILE4 model are based on motor vehicle operating conditions typical of peak one-hour and eight-hour periods. In addition, the analysis

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* EPA, Guidelines for Air Quality Maintenance Planning and Analysis Volume 9, (Revised): Evaluating Indirect Sources, Second Printing, EPA-450/4-78-001, Research Triangle Park.

** EPA, User's Guide to MOBILE4: Mobile Source Emissions Factor Model, EPA-AA-TEB-89-01, Ann Arbor, MI, February, 1989.

*** Parsons, Brinkerhoff Quade & Douglas, Inc., "Users Guide to CAL3QHC", September 1990.

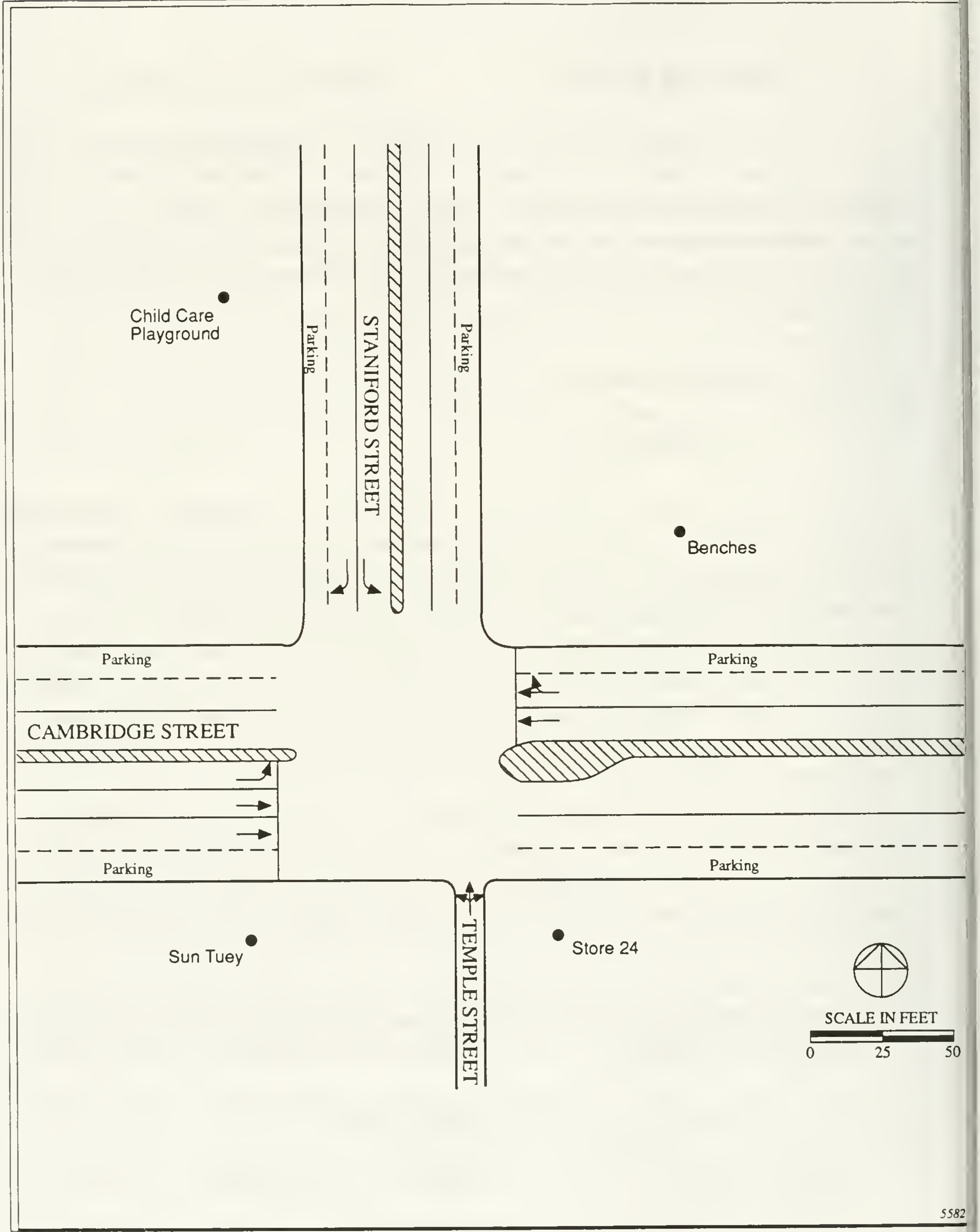

FIGURE V-5.1
INTERSECTION GEOMETRY AND RECEPTOR LOCATIONS
CAMBRIDGE / STANIFORD / TEMPLE

incorporated the effects of the Commonwealth's statewide Inspection and Maintenance (I&M) program designed to control emissions of CO from motor vehicles. These emissions data were used as input to the CAL3QHC model to predict CO concentrations. MOBILE4 and CAL3QHC modeling methodologies are detailed in Appendix C.

Peak PM traffic data generated for the Transportation Access Plan Component of the DPIR/DEIR are used in the air quality analysis to reflect worst case traffic conditions. Peak eight-hour volumes for approaches at the intersection are calculated by factoring the peak PM one-hour traffic data to reflect the average hour in the peak eight-hour period. A peak eight-hour to one-hour factor of 0.78 is used.

5.4.2 Results

The maximum predicted one-hour and eight-hour CO concentrations at sensitive receptors at the Cambridge Street/Staniford Street intersection are presented in Table V-5.1. The values represent the highest potential concentrations that might exist during the simultaneous occurrence of worst case meteorology and peak traffic conditions. Typical pollution levels are expected to be lower than these worst case values.

The results of the air quality study indicate that because the proposed Shriners Burns Institute generates little new traffic in relation to existing peak conditions, it has no impact on the maximum predicted CO concentrations.

Three of the four receptors studied show compliance with the one-hour and eight-hour NAAQS for future no-build and build conditions. The Cambridge Street/Staniford Street intersection, however, has predicted maximum CO concentrations above the 8-hr NAAQS for both the existing (1991) and future (1994) conditions. Under existing conditions, the Sun Tuey receptor has a maximum predicted concentration of 16.6 ppm, 7.6 ppm above the allowed 9.0 ppm standard. This level decreases in the future to 13.8 ppm for both the future build and no-build cases, still 4.8 ppm above the 9.0 ppm standard. Therefore, exceedances are a result of conditions independent of the propossed Shriners Burns Institute. Further, the project does not exacerbate these exceedances.

The one-hour concentrations at this receptor are below the NAAQS of 35.0 ppm for the existing, future no-build and build conditions.

TABLE V-5.1

CAMBRIDGE STREET/STANIFORD STREET INTERSECTION MAXIMUM PREDICTED CO CONCENTRATIONS (PPM)

	1989 Existing		1994 No-Build		1994 Build	
Receptor Name	1-Hr	8-Hr	1-Hr	8-Hr	1-Hr	8-Hr
1 - Benches	13.8	6.9	12.1	6.3	12.1	6.3
2 - Store 24	19.2	9.0	16.5	7.7	16.5	7.7
3 - Sun Tuey	32.2	16.6	26.6	13.8	26.6	13.8
4 - Playground	15.1	7.0	13.2	6.3	13.2	6.3

Notes: Background levels included: 5.0 ppm (one-hour) and 3.0 ppm (eight-hour).

National Ambient Air Quality Standards (NAAQS): 35 ppm (one-hour) and 9.0 ppm (eight-hour).

5.5 Garage Ventilation Analysis

5.5.1 Methodology

An ambient air quality analysis for the 1994 build case was performed to determine the impacts of the proposed underground parking garage ventilation system. The garage will be serviced by two exhaust vents. Current plans show the exhausts to be located above the first floor on the Blossom Street side of the Hospital. For analysis purposes, the vents are conservatively modeled as co-located (in the same location).

The analysis utilizes Volume 9 Guidelines* and MOBILE4 to generate emissions from the garage vents for the area peak traffic hour (4:30 to 5:30 PM), the peak 8-hour period as well as the garage peak traffic hour, which occurs during midday. PM peak hour traffic data was analyzed to determine the worst case emissions from the garage. Garage peak and peak eight-hour traffic data was provided by the transportation engineers for this analysis.

To conservatively predict the traffic impacts corresponding to the garage peak hour, peak PM traffic was used in conjunction with the eight-hour average background. Peak PM traffic data generated for the Transportation Access Plan Component of the DPIR/DEIR was used in the air quality analysis. A peak eight-hour to one-hour factor of 0.78 was used to calculate peak eight-hour average traffic. Using emission data and current design characteristics for the ventilation system, concentrations of CO at the ventilation exhaust exits were determined. These concentrations were then used to determine ground level concentrations at seven receptor locations around the project using Halitsky's gas diffusion equation.* Predictions were conducted for the peak PM traffic hour, the worst case eight-hour period, and peak hour for the garage. Figure V-5.2 shows exhaust location and sensitive receptors.

To determine total CO concentrations at each receptor, for comparison with NAAQS, one- and eight-hour traffic on Blossom Street and Cardinal O'Connell Way was also included in the analysis. CAL3QHC was used to calculate maximum impacts from motor vehicles on these streets at the seven receptors.

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* EPA, Guidelines for Air Quality Maintenance Planning and Analysis, Volume 9, (Revised): Evaluating Indirect Sources, EPA-450/4-78-008.

Further description of the ventilation system specifications, and parking garage air quality analysis are provided in Appendix C.

5.5.2 Results

Table V-5.2 presents results of the garage ventilation analysis for both the maximum one-hour and eight-hour averaging periods. Concentrations presented are ambient levels at the exhaust exits and at sensitive receptors away from the exhaust location; all totals include background concentrations of 5.0 ppm for the one-hour case and 3.0 ppm for the eight-hour and garage peak cases, as well as worst case impacts of traffic on Blossom Street and Cardinal O'Connell Way for each receptor. These results conservatively assume worst case meteorology occurring simultaneous with maximum garage exhaust concentrations and maximum street traffic impacts at receptors.

Maximum concentrations at the seven ground-level receptors, with background CO, are below NAAQS for one-hour and eight-hour cases. CO levels fall off further from the exhaust exit locations. At all receptors, 1-hour predicted CO concentrations range from 5.8 to 7.4 ppm and 8-hour concentrations range from 3.5 to 4.2 ppm. Peak hour traffic in the garage has a maximum receptor concentration of 4.6 ppm. Modeling of garage impacts demonstrates minimal concentrations at all the receptors examined. The maximum one-hour and eight-hour concentration for the garage alone is 0.2 ppm, therefore receptor concentrations are mostly dominated by background and traffic sources.

5.6 Laboratory Vent Analysis

Laboratory (fume hoods) and general hospital exhaust will be vented from the proposed projects' roof top near the southwest corner. Presently the design characteristics of these systems are incomplete, however, the ventilation system will be designed to meet building codes including sufficient turn over rates. For the hospital's general exhaust system, air contaminant levels are expected to be comparable with background levels as indoor air will be recirculated with outside air. The clean environment of the hospital is not expected to contaminate outside air.

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* Meteorology and Atomic Energy, 1968, p. 247.

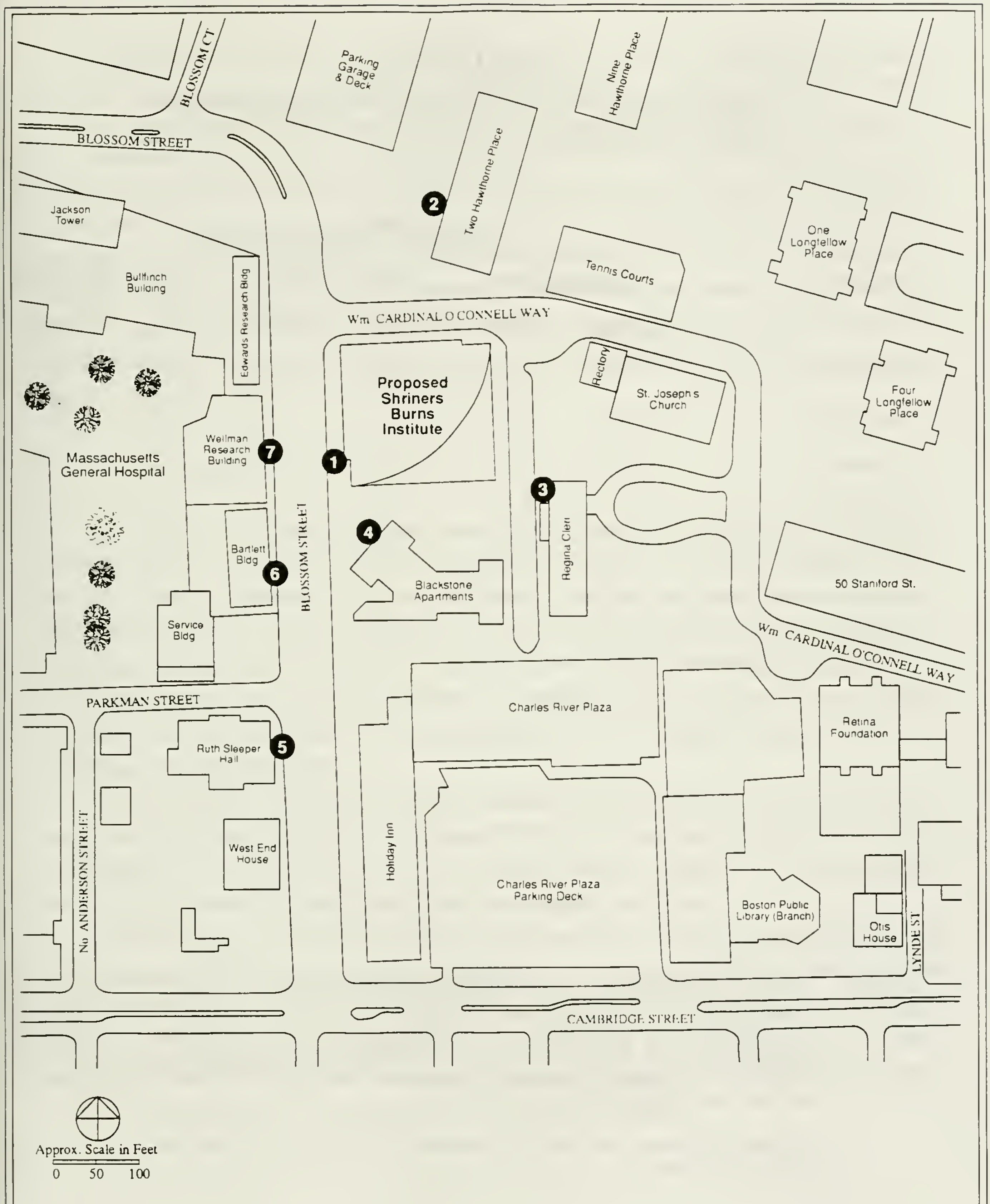

FIGURE V-5.2
GARAGE VENTILATION EXHAUST EXITS AND RECEPTORS

TABLE V-5.2

SHRINERS BURNS INSTITUTE PROPOSED GARAGE MAXIMUM AMBIENT AIR QUALITY IMPACTS (PPM)

Location	Predicted Concentration (ppm)					
	PM Peak Hour		8-Hour Average		Garage Peak Hour	
	Garage	Total*	Garage	Total*	Garage	Total*
Receptor 1	0.2	7.4	0.1	4.2	0.2	4.6
Receptor 2	0.1	6.0	0.1	3.6	0.1	3.7
Receptor 3	0.1	5.8	0.1	3.5	0.1	3.6
Receptor 4	0.1	6.3	0.1	3.7	0.1	3.9
Receptor 5	0.1	7.0	0.0	3.9	0.1	4.3
Receptor 6	0.1	6.9	0.1	4.0	0.1	4.3
Receptor 7	0.1	7.0	0.1	4.0	0.1	4.2

Notes: *Total concentration is the combined impact of the garage maximum and CAL3QHC predicted maximum impacts of Blossom Street and Cardinal O'Connell Way (regardless of direction) for each receptor. Background concentrations of 5 ppm for the PM peak hour and 3 ppm for the garage peak and 8-hour average are included. PM peak hour traffic for the 1994 build case is used for the garage peak hour.

National Ambient Air Quality Standards (NAAQS): 35 ppm (one-hour) and 9.0 ppm (eight-hour).

Similar to the existing conditions at the Shriners Burns Institute, fume hoods are present in the proposed Institute to vent intermittent work conducted in facility laboratories. Materials vented are typically in small quantities and typical of hospital uses, eg. formaldehyde. Based on data provided to the DEP by the hospital, there are no volatile/halogenated organic compounds presently being stored in bulk or being used in significant quantities for processes used at the facility. These laboratory operations are not expected to change significantly from present conditions as a result of the project. In addition, because hood exhaust is presently vented from the hospital's roof and will continue to be vented from the roof of the taller proposed facility, additional dilution of already small quantities of laboratory exhaust is expected with construction of the nine story proposed project.

5.7 Mitigation

The results of the air quality study indicate that because the proposed Shriners Burns Institute generates little new traffic in relation to existing peak conditions, it has no impact on the maximum predicted CO concentrations. Each of the receptors studied show compliance with the one-hour NAAQS for the existing, future Build, and No-Build uses. Although the eight-hour NAAQS is exceeded under existing conditions at one receptor, the exceedance is a result of conditions independent of the proposed Shriners Burns Institute. Further, the project does not exacerbate this exceedance and is, therefore, in compliance with the NAAQS.

For the garage ventilation analysis, maximum concentrations at seven ground-level receptors, with background CO, are below NAAQS for one-hour and eight-hour cases. CO levels fall off further from the exhaust exit locations. Modeling of garage impacts demonstrates minimal concentrations at all the receptors examined.

The Commonwealth's I&M program began on April 1, 1983, and has been assumed in the calculation of motor vehicle emission rates. This program, which results in the overall reduction of yearly motor vehicle emissions, was established to ensure compliance with the NAAQS on a statewide basis, as outlined in the Massachusetts State Implementation Plan. The attainment and maintenance of the NAAQS for CO in the future is dependent on the continued enforcement of this program.

Other traffic-related mitigation measures to reduce vehicle conflicts and delays could similarly improve air quality. The Transportation Impact Analysis of the FEIR outlines transportation management strategies which the Shriners Burns Institute currently employs including flexible work schedules, and plans to promote ridesharing and greater transit usage. Because the project has no predicted air quality impact at the Cambridge Street/Staniford Street intersection, further mitigation is not proposed.

6.0 GEOTECHNICAL ANALYSIS

6.1 Subsoil Conditions

Based on available geological data and on subsurface explorations in the immediate area, generalized subsurface soil and rock types are as discussed below in increasing order of depth below existing ground surface.

Miscellaneous granular fill associated with building and utility construction is anticipated to depths of about 12 feet. The composition of the fill is most likely highly variable but typically consists of compact sand, silt and gravel with minor concentrations of wood, cinders, concrete, and other miscellaneous materials.

Underlying the fill, a deposit of marine clay varying from 20 to 35 feet in thickness is anticipated. The marine clay is a stiff to very stiff gray silty clay.

The marine clay is underlain by a deposit of very dense gray glacial till. The glacial till deposit generally consists of a well-graded mixture of silt, sand and gravel containing numerous cobbles and boulders. The till deposit is anticipated to be on the order of 10 to 15 feet in thickness and to be directly underlain by the bedrock surface.

The argillite bedrock surface is most likely sloping downward east to west approximately 45 to 55 feet below the existing ground surface. Typically, the argillite is a steeply-bedded shale-like rock of quite variable quality.

6.2 Groundwater

Based upon other work conducted in the area, groundwater is anticipated to be "perched" or trapped on the surface of the marine clay deposit varying from Elevation +10 to Elevation +14 across the site. Therefore, any dewatering is anticipated to be minor in scope. Groundwater levels vary due to environmental factors such as precipitation and changes in existing drainage patterns.

Groundwater observation wells will be installed around the perimeter of the site to allow the Geotechnical Engineer to monitor the groundwater levels during the construction period to ensure that groundwater levels are maintained prior to, during, and after construction.

6.3 Foundation Design

Foundation support of the new nine-story hospital facility with two and a half levels of below-grade parking is anticipated to be by means of rock-socketted caissons drilled into the argillite bedrock in consideration of the relatively high loadings carried by the Phase I columns.

Although the lowest level parking slab is below the groundwater level, it is anticipated that the perimeter walls can be sealed into the impervious marine clay and glacial till deposits to create a groundwater cut-off, and the lowest level slab will be protected against groundwater intrusion by a conventional underslab drainage system. Sealing the perimeter walls into the impervious subgrade and backfilling the perimeter walls with impervious material will maintain the existing groundwater adjacent to the project at its pre-construction level.

6.4 Foundation Construction Methodology

In order to ensure continuous service at the Shriners Burns Institute, the first phase of development will include construction of levels 5 through 9 of the new structure over the existing facility. During Phase I, the existing facility will remain in service. This will require erection of several long structural trusses to transfer the new structural loadings outside the footprint of the existing structure. Following completion and occupancy of levels 5 through 9, the existing structure will be demolished and levels 1 through 4 as well as 2½ levels of below-grade parking (100 cars maximum) will be constructed.

Foundation support for these structures will be provided by rock-socketted caissons which will be installed utilizing conventional rotary drilling techniques.

Following completion and occupancy of the Phase I structure, Phase II construction will commence with demolition of the existing hospital structure. Excavation for the below-grade portion of the new structure will follow and will be performed entirely within an enclosure formed by either continuously interlocking steel sheet piling or soldier piles and lagging. A soldier pile and lagging earth support system incorporates vertical steel beams known as "soldier piles" set at intervals around the perimeter of the site with wooden planks referred to as "lagging" spanning between the vertical soldier piles to retain the adjacent soil. Soldier piles, if utilized, will be placed within pre-drilled holes so as not to cause undue vibrations at adjacent structures. Lateral restraint of the earth support system will be provided by means of either internal bracing or external tiebacks. As these systems are installed, the excavation proceeds incrementally with the proper bracing being installed to ensure continuous support throughout.

Excavation will be conducted by conventional earth excavation equipment, primarily hydraulic backhoes, removing approximately 5,000 cubic yards of soil which will be loaded directly into trucks and disposed of off-site in accordance with the Commonwealth of Massachusetts Department of Environmental Protection's solid waste disposal regulations.

The lateral earth support system will be designed by registered professional engineers working in consultation with the Geotechnical Engineer. The installation and performance of the lateral earth support system will be continuously monitored by the Geotechnical Engineer during the foundation phase of construction to mitigate adverse movements.

The above construction methodology has been specifically chosen to not only provide the necessary foundation support for the proposed structure during all phases of the construction, but also to protect the adjacent structures, streets and utilities from adverse effects attributable to the proposed construction.

6.5 Foundation Construction Mitigation Measures

Measures that are expected to be employed to prevent and mitigate potentially adverse effects of the proposed below-grade construction fall into four general categories:

a) Preventive Design
b) Construction Performance Criteria
c) Monitoring During and After Construction
d) Pre-Determined Mitigation Measures

The excavation procedures and lateral support system will be designed to prevent adverse effects in consideration of the sensitive nature of nearby structures. Specific performance criteria will be incorporated into the contract documents for construction of the project. The contractor and the proponent's geotechnical engineer will monitor excavation performance for early detection of movements. The monitoring is to enable implementation of mitigation measures, if necessary, before adverse effects can result.

Specific performance criteria will be imposed on the contractor during excavation and below-grade construction. The proponent will require that the excavation and adjacent structures be monitored to specifically prohibit inappropriate construction practices which are known to contribute to unfavorable performance. The project specifications will include criteria for undertaking remedial measures if movement of the lateral support system or underpinning system exceeds a specified limit.

The proponent's geotechnical engineer will review the contractor's design submittals for the lateral earth support and underpinning systems of conformance to the criteria and specified performance requirements. Revisions will be recommended and implemented, as necessary, to achieve conformance.

Full-time, on-site monitoring of the contractor's construction activities will be provided by the proponent's geotechnical engineer until the below-grade portions of the structure are completed. This will provide for independent monitoring of the contractor's compliance with the project specifications, and will enable early notification and correction of on-site problems.

The project proponent will also install and monitor appropriate survey points and geotechnical instrumentation to document the performance of the excavation and effects on nearby facilities. Such monitoring is planned to include measurements of building settlements, ground and earth support system movements, and other data. This information can provide aid in warning of unacceptable excavation performance and enable corrective procedures to be implemented.

With the design submittals, the contractor will be required to provide contingency procedures to be reviewed by the proponent's design team prior to construction and undertaken in the event of excessive excavation movement. Such measures might include altering the excavation procedure or installation of additional bracing. These procedures are consistent with accepted construction practice.

7.0 SOLID AND HAZARDOUS WASTE ANALYSIS

7.1 21E Summary

A preliminary environmental site assessment was conducted by Hidell-Eyster Technical Services, Inc. and submitted to the Shriners Burns Institute on July 30, 1991. The research conducted by Hidell-Eyster consisted of a physical site inspection and interviews with Institute officials regarding the use and disposal of hazardous materials, a review of material safety data sheets maintained by the Institute, and a review of disposal methods for medical, solid, hazardous and radioactive wastes. Hidell-Eyster reviewed public records at the Department of Environmental Protection, and the Federal RCRA database, the CERCLA and national priority lists, and privately compiled historic and land use mapping. A review of records and testing with regard to the 1,000 gallon underground oil storage tank on-site (installed in 1987) which holds fuel for the emergency generating system, was also conducted by Hidell-Eyster. In the opinion of Hidell-Eyster, the site does not present a threat to the environment or to the safety, health and convenience of the public, as defined in MGL Chapter 21E, and no evidence of a release of hazardous materials or petroleum products was found.

7.2 Construction Waste

7.2.1 Demolition Debris

The demolition work for the proposed Shriners Burns Institute is anticipated to last approximately ten weeks. During the demolition period, seven trucks of demolition debris will be removed daily from the site. Each truck holds approximately 30 to 40 cubic yards of debris, totalling approximately 245 cubic yards per day. The project will generate approximately 6,000 cubic yards of demolition debris. Construction debris will consist primarily of wood, metal, and non-contaminated steel and approximately 75% of the debris will be recyclable (wood, steel, masonry).

7.2.2 Debris Composition and Disposal Sites

Prior to demolition or construction, the Shriners Burns Institute will hire a qualified professional to determine if there is any asbestos in the existing building. If any exists, the Shriners will have it removed by a licensed contractor prior to any demolition. Any contaminated waste will be handled and disposed of by a licensed contractor in an approved landfill in compliance with all applicable local and state regulations.

The bulk of the construction debris will consist of non-contaminated steel, metal, wood, brick, and roofing material. Some of the steel, wood, and metal may be salvaged, and the rest will be removed by the contractor. The waste will be disposed of in an approved landfill under the authority of the contractor. To prevent the accumulation of debris on-site, disposal of debris will be carried out while the demolition is occurring. The naming of specific sites for disposal is premature at this time since conditions and available disposal sites may change by the time construction begins. The demolition contractor will, however, assume full responsibility for disposing the debris efficiently and appropriately in accordance with applicable regulations.

7.3 Operational Waste

Upon completion of construction, solid waste generated by the proposed Shriners Burns Institute project will increase as a result of new research, office, and outpatient examination rooms. The estimated operational waste from the proposed office space is based on current rates of waste generation at the Shriners Burns Institute and assuming similar rates for the additional office space. Similarly, to determine the amount of waste from the proposed research and outpatient space, current rates of waste at the Shriners Burns Institute have been calculated and applied to the project.

7.3.1 Office Waste

Increase in office space will result in an increase of approximately 8.92 tons per year, as shown on Table V-7.1. It is anticipated that the waste will continue to be picked up every other week by BFI Industries.

7.3.2 Radioactive Waste

As shown on Table V-7.1, the increase of 40 researchers is expected to result in an additional 335 gallons of radioactive waste per year. The waste is expected to be disposed of as it is currently. The radioactive waste generated by the research laboratories is disposed of by each individual laboratory. The waste is separated and packaged and taken

TABLE V-7.1

WASTE GENERATED BY THE EXISTING SHRINERS BURNS INSTITUTE

Type	No. of Employees/ Patients	Solid Waste	Estimated Annual Generation Rate/ lbs/person
Office*	210	156 tons/year	1,486 lbs/person
Radioactive (based on number of researchers)	60	402 gallons/year	6.7 gallons/year
Patient Medical Waste (based on number of patients)	30**	19.77 tons/year	1,318 lbs/person
Research Medical Waste (based on number of researchers)	60	6.2 tons/year	208.50 lbs/person

ESTIMATED NET NEW WASTE FROM THE PROPOSED SHRINERS BURNS INSTITUTE

Type	No. of Employees/ Patients	Estimated Annual Generation Rate/ lbs/person	Solid Waste
Office*	12	1,486 lbs/person	8.92 tons/year
Radioactive (based on number of researchers)	50	6.7 gallons/year	335 gallons/year
Patient Medical Waste (based on number of patients)	45**	1,318 lbs/person	29.66 tons/year
Research Medical Waste (based on number of researchers)	50	208.50 lbs/person	5.21 tons/year

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* Also includes doctors, administrative and custodial staff.

** Number of outpatients per clinic. The hospital conducts the clinic a minimum of three times per week.

to the Massachusetts General Hospital dumpster dock where a technician from the Harvard University Environmental Health and Safety Department accepts it for disposal. The waste is picked up twice a week.

According to a representative of the Harvard University and Harvard Affiliated Radiation Protection Program through Massachusetts General Hospital, if the radioactive material is short-lived, it is decay-stored until no longer radioactive and is then disposed of. If the radioactive material is not short-lived, it is sent to a broker who disposes of the material. The brokers which currently receive the radioactive waste are located in Florida or Washington. Beginning in 1993, the waste sent to Washington will remain in Massachusetts.

7.3.3 Medical Waste

The additional annual medical waste resulting from the increase in patients and researchers is estimated to be approximately 34.87 tons per year. The waste is picked up every morning by BFI Industries in Lawrence, Massachusetts and will continue to be picked up daily. The estimate may be high because it represents a straight line extrapolation from the existing patient mix, which includes in-patients. The expected 45 patient increase will consist solely of out-patients who will be present on the premises only for a few hours each visit. Presumably the out-patients will generate less waste than in-patients who are present 24 hours a day.

7.4 Recycling

It is anticipated that the new space for the dumpster will allow recycling bins to allow the initiation of a recycling program. The program is expected to include waste reduction techniques as well as recycling.

7.5 Mitigation

7.5.1 Solid Waste

It is anticipated that the new space for the dumpster will allow for recycling bins to initiate a recycling program. The program is expected to include waste reduction techniques as well as recycling.

Following is a list of some of the waste reduction measures that are being considered for the new building in addition to the implementation of a paper recycling program:

- Adding a second compactor for paper, cardboard, and plastics in the loading dock (space has been allocated);
- Working with the Purchasing Department to use vendors and products that use less corrugated cardboard (i.e., using paper towel rolls rather than multi-fold towels which are packaged in corrugated cardboard);
- Installing a cardboard baler which compacts and bales corrugated cardboard; and
- Working with vendors to supply medical supplies that can be reused or recycled rather than disposed of.

The specific waste programs will be finalized as the project progresses.

7.5.2 Hazardous Waste

Based on the preliminary environmental site assessment, the site does not present a threat to the environment or to the safety, health, and convenience of the public as defined in MGL Chapter 21E, and no evidence of a release of hazardous materials or petroleum products was found.

8.0 OPERATIONAL NOISE ANALYSIS

8.1 Introduction

Both the existing Shriners Burns Institute and proposed Replacement Facility will produce sounds that can be measured beyond the property boundary. The following noise analysis contains a discussion of the existing noise environment, of noise sources at the existing facility and of the potential impact on the existing noise levels from proposed sources. It is concluded from this analysis that the noise from the proposed facility is expected to comply with the City of Boston A-Weighted Noise Standards and the Massachusetts Department of Environmental Protections's (DEP's) noise policy.

The facility is located at the intersection of Blossom Street and Wm. Cardinal O'Connell Way in Boston, Massachusetts. The primary noise source at the existing facility is the mechanical equipment located on the fourth floor penthouse/roof level. Similar equipment will be installed in the Replacement Facility and will be located on the fifth floor of the proposed nine-story structure immediately above the existing penthouse. Most of the equipment operates 24 hours per day, seven days per week. Other pieces of equipment cycle on and off during periods of reduced demand such as nighttime and weekend hours. Since all of the equipment may be operating at any time, it is assumed for the purposes of this analysis that all equipment is in constant operation (a worst case scenario).

8.2 Noise Impacts and Noise Metrics

8.2.1 Noise Defined

Noise is officially defined as "unwanted sound". Imbedded in this definition are the two principal features of noise: it is sound; and there must be someone hearing it who considers it to be unwanted. Noise is a common feature of our everyday lives. Frequently, most of us ignore it, but on occasion it becomes disturbing and disruptive to our activities.

8.2.2 Effects of Noise

Noise assessment requires developing relationships between the physical properties of a sound field, which can be measured with instruments; and people's reaction to the sound, which must be measured with psychological or sociological tools. Some of the common noise impact assessment tools are:

- Annoyance

  When polls are conducted, some people report that they are "highly annoyed" by noise. The percentage claiming to be highly annoyed increases with the magnitude of the sound level in their environment; but some people (about 10%) are highly annoyed regardless of how quiet their sound environment is, and others (10% to 20%) are never annoyed regardless of the loudness of their environment. People tend to be more annoyed by sounds at night than in the daytime, more annoyed when at their homes than when travelling or at work and more annoyed by new sounds than by familiar ones. The extent of people's annoyance with sounds may be related to their control over and attitude towards the sound source.

- Activity Interference

  Sound can interfere with human activities by limiting speech communication or the ability to listen to the telephone, radio or television. Sounds can also interfere with concentration and with sleep. (There is wide variability among people, and from occurrence to occurrence for a given person, in the effects of sound on sleep.) The potential for activity interference as caused by noise has been considered by the United States Environmental Protection Agency (USEPA) in their "Levels" document[1].

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[1] Information on Levels of Environmental Noise Requisite to Protect the Public Health and Welfare with an Adequate Margin of Safety, USEPA Document 550/9-74-004, March, 1974.

- Health Effects

  The most obvious health effect of noise is that intense exposures, such as to a nearby explosion; or prolonged exposure to very loud sounds can lead to loss of hearing. Stress effects (changes in heart rate, blood pressure, etc.) have also been observed in high noise levels. Avoidance of the potential for hearing damage to people at work is the basis for the occupational noise exposure limits promulgated by the United States Occupational Health and Safety Administration (OSHA)[2].

When evaluating noise impacts it is important to remember that noise regulations and guidelines are attempts to set quantitative limits to sounds - something that can be measured with an instrument - in order to protect against a typically subjective human reaction. Although the sound limit may be discrete, human reactions are highly variable. Noise in communities is almost always a quality-of-life issue and almost never a health issue. As such, it is appropriate that noise regulations or guidelines be protective of the "average" community or of "most" persons. It is not possible for any guidance to satisfy everyone, just as it is not possible to tell people what will or will not annoy them.

8.2.3 Noise Metrics

There are a number of ways in which sound (noise) levels are measured and quantified. All of them use the logarithmic decibel (dB) scale. The following is a brief introduction to the noise measurement terminology used in the noise analysis.

The Sound Level Meter used to measure noise is a standardized instrument.[3] It contains "weighting networks" to adjust the frequency response of the instrument to approximate that of the human ear under various circumstances. One network is the **A-weighting** network. (There are also B- and C-weighting networks.) Sounds are frequently reported as observed with the A-weighting network of the sound level meter. A-weighted sound levels emphasize the middle frequency (i.e. middle pitched - around 1,000 hertz [Hz]) sounds, and de-emphasize lower and higher frequency sounds. A-weighted sound levels are reported in decibels designated as "dBA".

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[2] 29 CFR Ch. XVII, § 1910.95.

[3] American National Standard Specification for Sound Level Meters, American National Standards Institute (ANSI) S1.4-1983, published by the Standards Secretariat of the Acoustical Society of America, NY.

Because the sounds in our environment usually vary with time they cannot simply be described with a single number. Two methods are used for describing variable sounds. These are exceedance levels and the equivalent level, both of which are derived from a large number of moment-to-moment A-weighted sound level measurements. Exceedance levels are values from the cumulative amplitude distribution of all of the sound levels observed during a measurement period. Exceedance levels are designated Ln, where n can have any value from 0 to 100 percent. For example:

- o L_{90} is the sound level in dBA exceeded 90 percent of the time during the measurement period. The L_{90} is close to the lowest sound level observed. It is essentially the same as the residual sound level, which is the sound level observed when there are no obvious nearby intermittent noise sources.

- o L_{50} is the median sound level: the sound level in dBA exceeded 50 percent of the time during the measurement period.

- o L_{10} is the sound level in dBA exceeded only 10 percent of the time. It is close to the maximum level observed during the measurement period. The L_{10} is sometimes called the intrusive sound level because it is caused by occasional louder noises like those from passing motor vehicles.

By using exceedance levels it is possible to separate prevailing, steady noises (the L_{90}) from occasional, louder noises (the L_{10}) in the noise environment.

The equivalent level is the level of a hypothetical steady sound that would have the same energy (i.e., the same time-averaged mean square sound pressure) as the actual fluctuating sound observed. The equivalent level is designated L_{eq}, and is also A-weighted. The equivalent level represents the time average of the fluctuating sound pressure, but because sound is reported on a logarithmic (dB) scale and the averaging is done with linear mean square sound pressure values, the L_{eq} is mostly determined by occasional loud, intrusive noises.

When a steady sound is observed all of the L_n and the L_{eq} are equal. The analysis of noises from operation of the Burns Institute in Section 8.5 of this analysis treats all noises as though they will be steady and continuous.

The day night sound level, or L_{dn}, is a special kind of equivalent level determined by adding a 10 dBA penalty to sounds occurring at night between the hours of 10:00 PM and 7:00 AM. The L_{dn} is a useful metric of community noise impact because people in their homes are much more sensitive to noise at night, when they are relaxing or sleeping, than they are to noise in the daytime. The day night sound level is favored by the USEPA and other agencies for rating community noise impacts. (See the reference in footnote 1.)

In the design of noise control treatments it is essential to know something about the frequency spectrum of the noise of interest. (Noise control treatments do not function like the human ear so simple A-weighted levels are not useful for noise-control design.) The spectra of noises are usually stated in terms of octave band sound pressure levels, in dB, with the octave frequency bands being those established by standard.[4] To facilitate the noise-control design process, the estimates of noise levels caused by the operation of the project in Section 8.5 are also in terms of octave band sound pressure levels.

8.2.4 Typical Noise Levels

Figure V-8.1 illustrates typical noise levels produced by noise sources familiar from everyday experience.

8.3 Existing Noise Environment

An ambient noise level survey was conducted to characterize the existing acoustical environment in the vicinity of the Shriners Burns Institute. The survey measure was conducted to the combined noise level from all local noise sources at each of the selected receptors. Significant noise sources in the area around the site include mechanical equipment at several institutional and residential facilities and traffic. Very low local traffic volumes were observed in the area during measurement periods, no more than two vehicles in any ten-minute sample. Minor contributions of insect noise and distant traffic

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[4] American National Standard Specification for Octave, Half-octave and Third-octave Band Filter Sets, ANSI S1.11-1966(R1975).

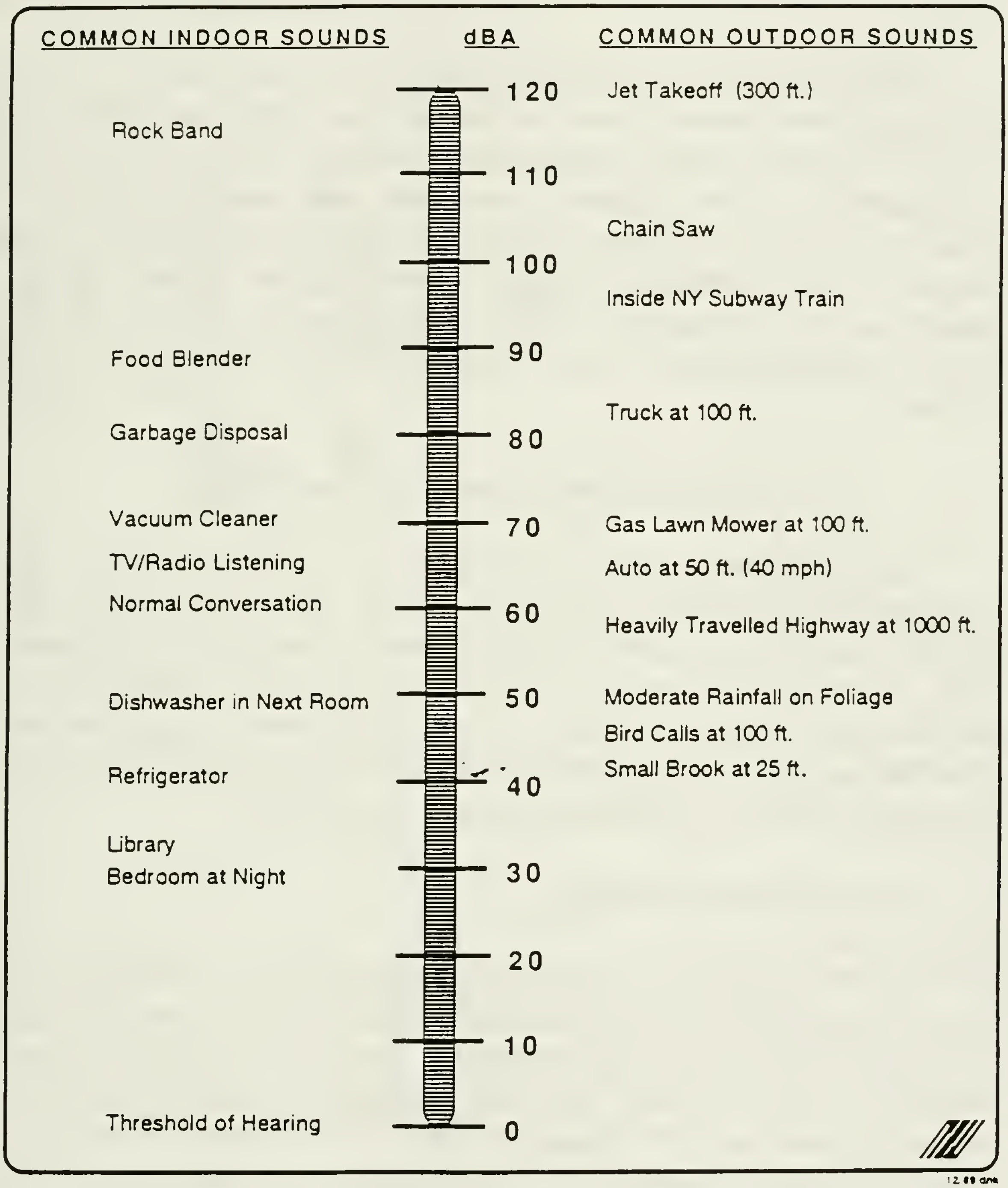

FIGURE V-8.1
TYPICAL A-WEIGHTED NOISE LEVELS IN THE ENVIRONMENT

noise were observed. Cricket noise was audible at several locations but was distant and infrequent. Traffic noise observed to be from Cambridge Street and Charles Street, approximately two blocks south and west respectively, was limited to occasional large trucks.

Ambient noise level measurements were made at several locations in the vicinity of the site which were representative of the residential and institutional facilities adjacent to the site. Since noise impacts are greatest when existing noise levels are lowest, the study was designed to measure community noise levels under conditions typical of a "quiet period" for the area. The results of the survey allow both quantitative and qualitative analyses of the acoustical environment surrounding the proposed facility. The characterization of the ambient sound levels addresses the acoustical effects of local traffic, nearby institutional and more distant commercial activities, and neighborhood activities.

8.3.1 Noise Measurement Locations and Local Buildings

A tour of the area around the proposed site was conducted to determine the location of the nearest noise sensitive receptors in the vicinity. Six measurement locations around the site were selected to obtain an adequate spatial representation of the ambient noise levels. The measurement locations are shown on Figure V-8.2. Buildings in the area are also identified on Figure V-8.2 and are described briefly below. Observations were made at curbside and are for the sole purpose of identifying existing sources of community noise and probable land uses of properties adjacent to the project site.

Noise Measurement Locations

Locations A and B are on the roof of the existing Shriners Burns Institute. Location A is on the northwest edge of the roof, overlooking the main entrance. Location B is on the southeast edge of the auditorium roof. The orientation of these locations in relationship to the building's mechanical equipment is identified on Figure V-8.4. Location C is northwest of the Regina Cleri House. This entrance, owned by St. Joseph's Church, is a shared accessway for the Church, Regina Cleri House and in part for the Shriners Burns Institute. Location D is on the sidewalk along Blossom Street to the west of Hawthorne Place tower. Location E is on the sidewalk along Wm. Cardinal O'Connell

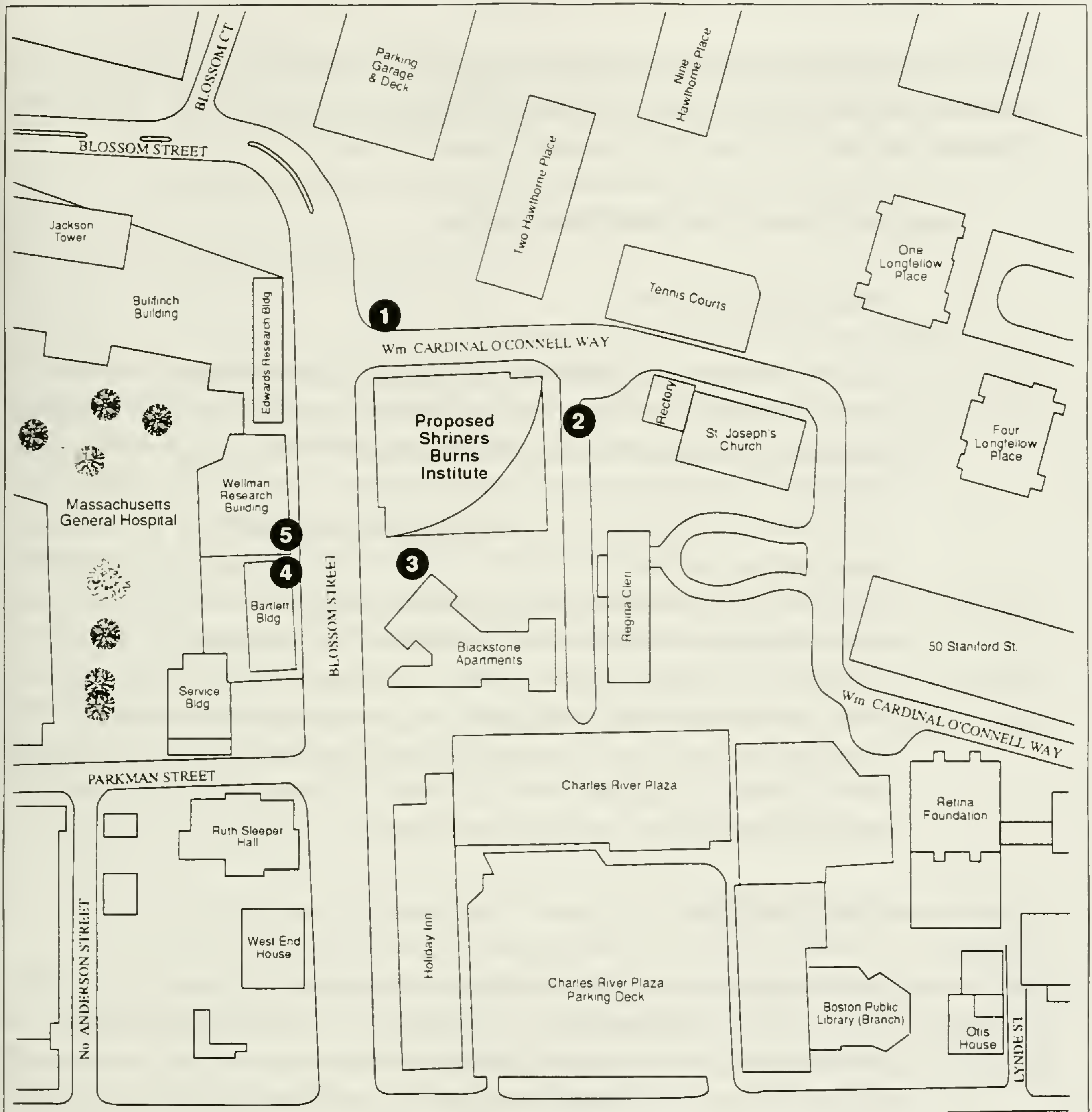

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FIGURE V-8.2
NOISE MEASUREMENT LOCATIONS AND LOCAL BUILDINGS

Way between Hawthorne Place tower and St. Joseph's Church rectory. Location F is on the sidewalk along Blossom Street between Blackstone Apartments and the Bartlett Building.

Local Buildings and Associated Noise Sources

- Shriners Burns Institute

  The existing four-story building is a hospital for research and treatment of burns. Operation of the facility requires substantial climate control equipment which is located in the 4th floor penthouse. Air is taken in and exhausted from this equipment through louvered openings in the walls of the penthouse. The equipment is the only nighttime noise source at the facility heard at any measurement location. An existing cooling tower is installed within the penthouse level behind a protective brick wall which extends from three feet above the building roof to the top of the penthouse (approximately 15 feet). The equipment was heard from several locations, but did not dominate the ambient noise levels at any measurement location. The Replacement Facility will be constructed on the same site with most potential noise sources to be located on the 5th floor. This would be directly above the existing Burns Institute mechanical equipment.

- Hawthorne Place

  The residential tower is located to the north-northeast of the site on the north side of Wm. Cardinal O'Connell Way. The building is approximately 16 stories tall and is the nearest of several residential towers in the same general area. Four vehicles entered or exited the facility during the measurement periods at several nearby locations. A security cruiser also drove through the parking lot during the measurement period.

- St. Joseph's Church

  The Roman Catholic Church shares a rear alley with the Shriners Burns Institute from O'Connell Way. A parking area between the two facilities is posted for use by the Church or the Regina Cleri House. Two vehicles drove in or out of the parking lot during the measurement period at a nearby location. The church rectory is located on the end of the building nearest the Burns Institute, so the property is considered to be a residential use.

- The Regina Cleri House

  The 10-story residential building to the southeast of the site is part of the St. Joseph's Church facility and is a home for retired priests. Nighttime noises observed near the building were from window air conditioning units installed in several of the apartments and the two vehicles already mentioned.

- The Blackstone Apartments

  The 11-story residential building is south of the site and abuts the Shriners Building. The nighttime noise observed from this property was from intermittent operation of HVAC equipment installed in each unit and visible from the outside. A newspaper truck also made a delivery during measurements at a nearby location.

- Bartlett Hall

  The eight-story Massachusetts General Hospital (MGH) residential building is southwest of the site, on the opposite side of Blossom Street. It is similar to and representative of several other residential buildings along Blossom Street which are farther from the site. Nighttime noise observed at this building was associated with numerous window air conditioning units operating intermittently.

- Wellman Research Building and Edwards Research Building

  The two MGH buildings are located to the west of the site, on the opposite side of Blossom Street. The seventh floor of the Wellman Building's 11 floors is covered by louvered openings, housing mechanical equipment. The cooling tower and other mechanical equipment located on the roof of the Edwards

Research Building could be heard operating at all measurement locations. Louvered openings also indicated more mechanical equipment in the top floor of this eight-story building. Additional mechanical equipment is located on the roof of MGH buildings to the west of the Edwards Research Building. Noise from this additional equipment was observed at the measurement location in front of Hawthorne Place. Both of these buildings are analysed as business uses.

8.3.2 Measurement Methodology

Measurements were made during a weekday nighttime period. Care was taken to measure samples of ambient noise which were typical of the local institutional and community activities. The measurements were timed to avoid high daytime traffic volumes and were made under modest temperature and low wind conditions. Patches of wet pavement remained in the area from an earlier light rain, but no standing water was observed. Local traffic noise was observed to be typical of operation on dry pavement. There was an insignificant amount of insect noise included in the samples. Data sampling was stopped during periods of outside intrusions such as aircraft pass-overs, emergency sirens, or helicopter activity at nearby hospital facilities. Data collection was resumed at the end of such intrusions, to fulfill the pre-defined 10 minute sampling period. The survey conditions are described below. Meteorological comments are based on on-site observations. A Dwyer handheld wind meter was used for wind measurements. A household alcohol thermometer was used for temperature measurements.

Conditions for Nighttime Ambient Noise Measurements

Time:	1:30 am to 4:30 am, Thursday, September 5, 1991
Meteorology:	Low overcast, 72°F, winds 0-3 mph from the southwest

8.3.3 Measurement Equipment

A Bruel & Kjaer (B&K) Type 2231 Modular Precision Sound Level Meter, equipped with a B&K Type 4155 half-inch Prepolarized Condenser Microphone and a three inch foam wind screen were used to collect statistical A-weighted ambient sound pressure level data. The instrumentation meets the "Type 1 - Precision" requirements set forth in

American National Standards Institute (ANSI) S1.4 (see footnote 3) for acoustical measuring devices. The meter was equipped with a B&K Type BZ 7101 Statistical Analysis Module, which automatically calculates the exceedance levels obtained during the sampling period. The meter was also equipped with a B&K Type 1625 octave band filter set meeting ANSI S1.11 standards which was used for the collection of the residual spectrum data. The measurement equipment was calibrated in the field before and after the survey with a B&K Type 4230 acoustical calibrator.

An octave band sound pressure level spectrum analysis was made at each receptor location during each measurement period. Residual sound pressure levels were measured within each of nine frequency ranges to quantify the general spectrum shape and frequency content of the existing ambient noise.

8.3.4 Survey Results

The results of the surveys are tabulated in Table V-8.1. Along with the quantitative values are provided lists of major sources of noise observed during each sampling period. Background (L_{90}) ambient sound pressure levels observed in the area of the project site ranged from 57 dBA to 62 dBA at street level and from 59 dBA to 65 dBA at the existing Shriners facility roof level.

8.4 Noise Regulations and Criteria

8.4.1 Applicable Noise Regulations

Noise impact is judged on two bases: the extent to which governmental regulations or guidelines may be exceeded, and the extent to which it is estimated that people may be annoyed or otherwise adversely affected by the noise. The governmental regulations that may be applicable to noise caused by activities at the project site are summarized below.

Federal

- Occupational Noise Exposure Standards: 29 CFR 1910.95.

TABLE V-8.1
RESULTS OF NIGHTTIME AMBIENT NOISE SURVEY

Thursday, September 5, 1991

RESIDUAL
OCTAVE BAND ANALYSIS
dB (re: 20 microPascals)

	Octave band center frequency (Hz)								
Position Description	31.5	63	125	250	500	1000	2000	4000	8000
A - Roof Northwest	70	74	71	69	66	59	54	45	37
B - Roof South	65	68	68	62	59	54	48	41	31
C - Regina Cleri Lot	63	64	62	60	57	51	46	42	40
D - Front of Hawthorn Pl	67	68	66	64	61	56	51	46	36
E - Near Tennis Courts	64	67	65	62	61	55	48	44	33
F - Front of Blackstone	63	64	62	60	57	51	46	42	40

AMBIENT NOISE LEVELS
dBA (re: 20 microPascals)

Position Description	**Time***	**L10**	**L50**	**L90**	**Leq**	**Noise Sources**
A - Roof Northwest	2:08	67	66	65	66	Mechanical equip. (Wellman, Shriners, MGH)
B - Roof South	2:24	61	60	59	60	Mechanical equip. (Wellman, Shriners, R.C house, Blackstone)
C - Regina Cleri Lot	3:40	58	57	57	57	Mechanical equip. (Wellman, Shriners, Blackstone, R. C. house), distant traffic, cricket, light breeze
D - Front of Hawthorn Pl	2:38	62	61	61	61	Mechanical equip. (Wellman, Shriners, MGH), traffic distant cricket
E - Near Tennis Courts	3:10	61	60	59	60	Mechanical equip. (Wellman, MGH, Shriners), distant traffic, distant cricket
F - Front of Blackstone	3:59	63	62	62	62	Mechanical equip. (Wellman, Blackstone, Shriners, Bartlett), traffic (Blossom, distant Cambridge)

* Start time of 10 minute sample (meter was stopped during intrusions of outside noise)

State

- o The State of Massachusetts Department of Environmental Protection's Noise Policy: DAQC policy 90-001.

Local

- o City of Boston Code - Ordinances: Section 16-26 Unreasonable Noise.
- o The City of Boston Air Pollution Control Commission Regulations for the Control of Noise in the City of Boston.

The federal regulation restricts the noise exposure of employees at the workplace as referred to in OSHA requirements. The state DEP policy limits pure tone conditions and source noise levels to 10 dBA above ambient measured at the project property line and at the nearest residence. It is assumed that the regulation of noise related to this project will be deferred by the DEP to the quantifiable standards established by the City of Boston. The first Boston regulation defines normal construction hours to be between 7:00 a.m. and 6:00 p.m. on weekdays and provides limits on construction noise produced outside this time period. The second Boston regulation establishes maximum allowable sound pressure levels by zoning district measured at the property line of the recieving property. Table V-8.2 outlines the standards that can be applied to the operation of the hospital.

8.4.2 Other Noise Impact Criteria

HUD Housing Regulations

The United States Department of Housing and Urban Development (HUD) has established regulations limiting the noise environment at locations where federal-aid housing is to be built.[6] According to the HUD regulations, sites where the L_{dn} does not

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[6] 24 CFR Part 51.

TABLE V-8.2
CITY OF BOSTON
TABLE OF ZONING DISTRICT NOISE STANDARDS
MAXIMUM ALLOWABLE SOUND PRESSURE LEVELS

Octave Band Center Frequency (Hz)	Residential Zoning District		Residential-Industrial Zoning District		Business Zoning District	Industrial Zoning District
	Daytime (dB)	All Other Times (dB)	Daytime (dB)	All Other Times (dB)	Anytime (dB)	Anytime (dB)
31.5	75	68	79	72	79	83
63	76	67	78	71	78	82
125	69	61	73	65	73	77
250	62	52	68	57	68	73
500	56	45	62	51	62	67
1000	50	40	56	45	56	61
2000	45	33	51	39	51	57
4000	40	28	47	34	47	53
8000	38	26	44	32	44	50
A-Weighted (dBA)	60	50	65	55	65	70

Notes:
- Noise standards are extracted from Regulation 2.5, City of Boston Air Pollution Control Commission, "Regulations for the Control of Noise in the City of Boston", adopted December 17, 1976.
- dB and dBA based on a reference pressure of 20 micropascals.
- Daytime refers to the period between 7:00 a.m. and 6:00 p.m. daily except Sunday.

exceed 65 dBA are acceptable for housing; sites where the L_{dn} is between 65 and 75 dBA are normally unacceptable but may be approved under special circumstances; and sites where the L_{dn} exceeds 75 dBA are unacceptable. It is assumed that HUD considered the potential for sleep disturbance in establishing these regulatory limits for housing sites.

8.5 Operational Noise Impacts and Mitigation Measures

Noise control is an inherent consideration in the design of a major urban facility. The noise control designers must analyze all of the potential noise sources at the facility and all of the noise propagation paths between these sources and sensitive locations inside and outside of the hospital. Specialized noise control treatment is then designed for each individual noise source identified as potentially producing excessive noise at sensitive locations.

At this point in time the Shriners Burns Institute is still in the preliminary design stage and detailed noise control studies have not yet been done. Nevertheless, the major potential sources of community noise have been identified. The following noise impact analysis focuses on these major sources, and demonstrates that it is feasible to design the facility so that it will not produce excessive noise at the boundaries of adjacent properties.

8.5.1 Noise Level Prediction Methodology

The analysis focuses on nighttime noise levels in the area because this is the most stringent noise-control design period for the facility. Residential land use is assumed for neighboring buildings with the exception of business (institutional) use for the Wellman Research Building and Edwards Research Building of Massachusetts General Hospital. For the puposes of this analysis, a location was selected in the vertical plane representing the property line which is likely to be exposed to the highest project noise levels. Since noise levels decrease with distance, more distant residential properties were not considered but will also meet the assigned criteria. Attenuation with distance is calculated as $-10\text{Log}[2\pi R^2]$, where R is in meters; minus air absorption for standard atmospheric conditions from Table 5.1 of the Edison Electric Institute's Environmental Noise Guide[7] (EEIG).

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[7] Published in 1978 and later revised by Edison Electric Institute, New York (now in Washington, DC), an electric utility trade group.

The noise sources at the facility emit sound energy primarily in one direction, directly out of the louvered opening (known as directivity). It is conservatively assumed that no energy is lost around the back side of the building (i.e., 1/4 spherical radiation is assumed). Directivity is similarly accounted for at locations very near a large source such as the fifth floor intake louvers. At small distances, the observed sound levels are dominated by the portion of the source nearest to the observer. This analysis assumes that the observed source size is limited to a radius equal to the source-reciever distance. For example, at 10 feet from a 50 x 12 feet louvered opening, the observed sound level is determined by an area 20 feet by 12 feet (maximum of 10 feet on either side of the nearest point)

The Replacement Facility will have similar equipment as is installed in the existing Burns Institute. The equipment will be placed on the fifth floor of the proposed structure which is immediately above the location of the existing mechanical equipment penthouse. The fifth floor equipment will include cooling towers, water chillers, HVAC air handlers and miscellaneous pumps. The preliminary equipment location is shown on Figure V-8.3. The approximate layout of the major equipment in the existing penthouse is shown on Figure V-8.4.

Octave band sound pressure level measurements were made of the existing facility noise sources to estimate the spectra of the proposed facility sources. The microphone was placed approximately two feet from the wall openings to prevent the sample from being contaminated by noise from another source or from the air moving through the opening. The measurement equipment and methodology used are described in Section 8.3.2. The measured spectra were scaled for the increased equipment power and wall opening area expected at the proposed facility. Predictions also reflect noise mitigation needed to assure the compliance of the facility with City of Boston standards. Specific noise reduction measures have not yet been determined, but noise reduction measures will be incorporated into later stages of facility design.

8.5.2 Predicted Facility Noise Levels

Results of the analysis are provided in Table V-8.3. Sound pressure levels are predicted for each major noise source at the adjacent property line. The point in space along the property line plane where the maximum is expected is identified in the table. Contributions from multiple sources are combined where appropriate.

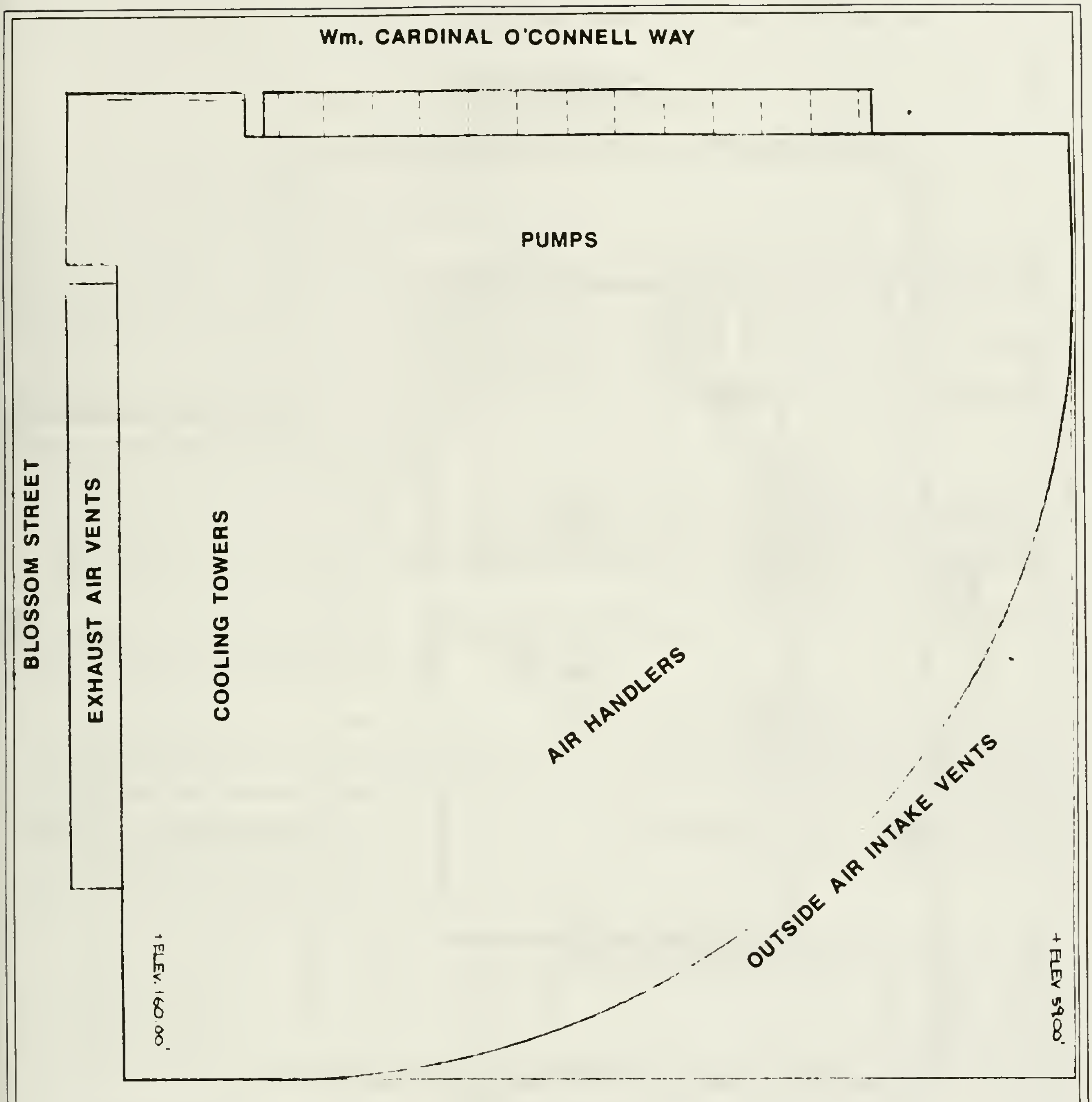
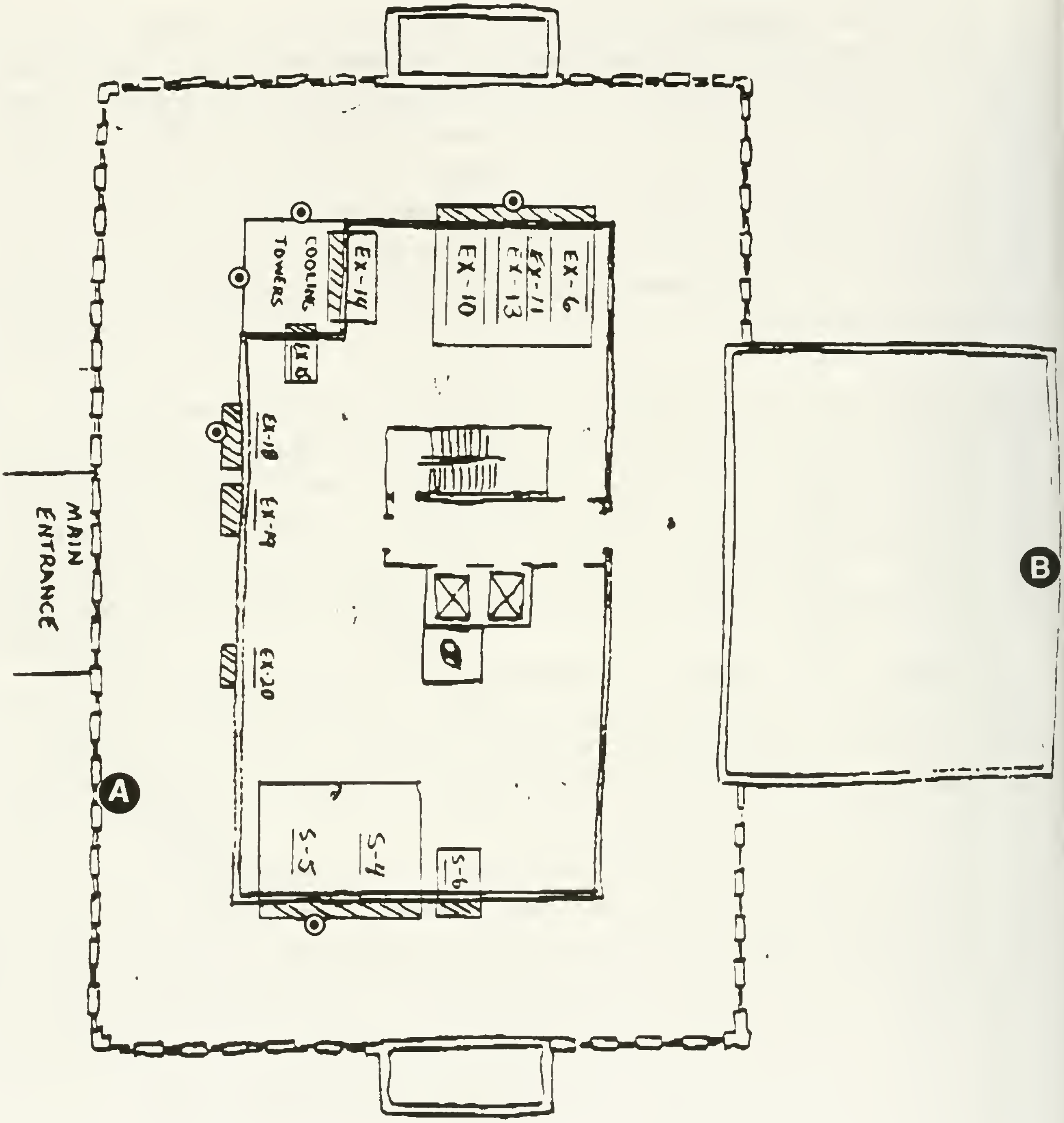


FIGURE V-8.3
APPROXIMATE LAYOUT OF PROPOSED MECHANICAL
EQUIPMENT AT 5TH FLOOR



● AMBIENT NOISE MEASUREMENT LOCATION

⊙ EQUIPMENT NOISE MEASUREMENT LOCATION

FIGURE V-8.4

APPROXIMATE LAYOUT OF EXISTING MECHANICAL EQUIPMENT

TABLE V-8.3
MAXIMUM PREDICTED NOISE LEVELS
dB (re: 20 microPascals)

Maximum sound levels expected, Hawthorne Place property line

Predicted at the southwest corner of the property, 5 floors elevation

	Combined	Octave Band Center Frequency (Hz)								
Contributing source(s)	dBA	31.5	63	125	250	500	1000	2000	4000	8000
5th floor exhaust vent	45	63	62	56	47	40	35	28	23	22
Garage exhaust vent (-3 dB)	39	47	52	50	43	36	26	24	13	3
Total	46	63	62	57	48	41	36	29	23	22
Boston Standard (res)	50	68	67	61	52	45	40	33	28	26

Maximum sound levels expected, Church property line

Predicted nearest intake vents, 5 floors elevation

	Combined	Octave Band Center Frequency (Hz)								
Contributing source(s)	dBA	31.5	63	125	250	500	1000	2000	4000	8000
5th floor intake vents	49	65	65	59	52	45	40	33	28	26
Total	49	65	65	59	52	45	40	33	28	26
Boston Standard (res)	50	68	67	61	52	45	40	33	28	26

Maximum sound levels expected Blackstone property line

Predicted nearest intake vents, 5 floors elevation

	Combined	Octave Band Center Frequency (Hz)								
Contributing source(s)	dBA	31.5	63	125	250	500	1000	2000	4000	8000
5th floor intake vents	49	65	65	59	52	45	40	33	28	26
Total	49	65	65	59	52	45	40	33	28	26
Boston Standard (res)	50	68	67	61	52	45	40	33	28	26

Maximum sound levels expected, Bartlett Hall property line

Predicted at the northeast corner of the property, 5 floors elevation

	Combined	Octave Band Center Frequency (Hz)								
Contributing source(s)	dBA	31.5	63	125	250	500	1000	2000	4000	8000
5th floor intake vents	39	58	57	50	43	35	27	19	13	8
5th floor exhaust vents	46	60	60	55	47	42	39	33	30	31
garage vents (-3 dB)	42	46	52	51	45	40	31	30	21	14
Total	48	62	62	57	50	45	40	35	31	31
Boston Standard (res)	50	68	67	61	52	45	40	33	28	26

Maximum sound levels expected, Wellman Building property line

Predicted at the southeast corner of the property, 5 floors elevation

	Combined	Octave Band Center Frequency (Hz)								
Contributing source(s)	dBA	31.5	63	125	250	500	1000	2000	4000	8000
5th floor intake vents	46	64	65	56	51	43	35	28	21	16
5th floor exhaust vents	54	67	67	62	55	50	47	42	39	40
garage exhaust (-3 dB)	50	53	59	58	53	48	40	40	31	24
Total	56	69	70	64	58	53	48	44	40	40
Boston Standard	65	79	78	73	68	62	56	51	47	44

8.5.3 Compliance to Regulations and Mitigation Measures

The Shriners Burns Institute has made a significant committment to noise control in the design of the facility. Construction of the Replacement Facility is expected to reduce the ambient noise levels present in the community. The City of Boston noise regulations will be complied with and, in fact, the levels are expected to be below the levels produced by the existing smaller facility. The larger structure of the Replacement Facility will also provide additional shielding of existing noise sources at some locations. Project related noise at the closest residences is also expected to be below the level considered by the Department of Housing and Urban Development as acceptable for housing.

Existing ambient noise levels were observed to exceed the City of Boston standards under conditions typical of the quiet periods for the area. By committing to comply with the Boston standard, the facility noise contribution will be well below the ambient levels. Noise reduction of various project related sources has been identified which will be necessary to achieve the overall noise control goals. Selection of the most appropriate noise control method will be identified in later stages of project design. These methods may include but are not limited to the following:

- Installation of Noise Control Louvers on some or all of the building openings.
- Installation of silencing material in the ductwork and plenums associated with the building's mechanical system.
- Arrangement of the various pieces of equipment on the fifth floor to minimize the noise exposure to building openings.
- Application of sound absorbtive material to noise sources or reflective surfaces around the sources.

9.0 CONSTRUCTION IMPACTS ANALYSIS

9.1 Construction Activity Schedule

A Construction Management Plan (CMP) will be submitted to the Boston Transportation Department for approval prior to the start of construction. The CMP includes specific mitigation measures and staging plans to minimize impacts to the abutters.

The construction period for the proposed Shriners Burns Institute is expected to last approximately 3½ years. Typical construction hours for the project will be from 7:00 AM to 3:30 PM, Monday through Friday, although steel erection, foundation preparation, concrete pouring, and masonry work may extend to 5:30 PM on weekdays. A preliminary construction schedule is shown on Figure V-9.1.

9.2 Construction Air Quality

Potential Impacts

Impacts associated with demolition, land clearing, ground excavation, and other construction activities may generate fugitive dust, which will result in localized increases in airborne particulate levels. Fugitive dust emissions from construction activities will depend on such factors as the properties of the emitting surfaces (e.g., soil silt content, moisture content, and volume of spoils), meteorological variables, and construction practices employed.

Mitigation

To reduce emissions of fugitive dust and minimize impacts on the local environment, a number of strictly enforced mitigation measures will be adhered to. These include:

- During dry periods, using wetting agents on areas of exposed soil and demolition activities on a scheduled basis.

- Using covered trucks for transportation of excavated material and demolition debris.

- Minimizing storage of debris on-site.

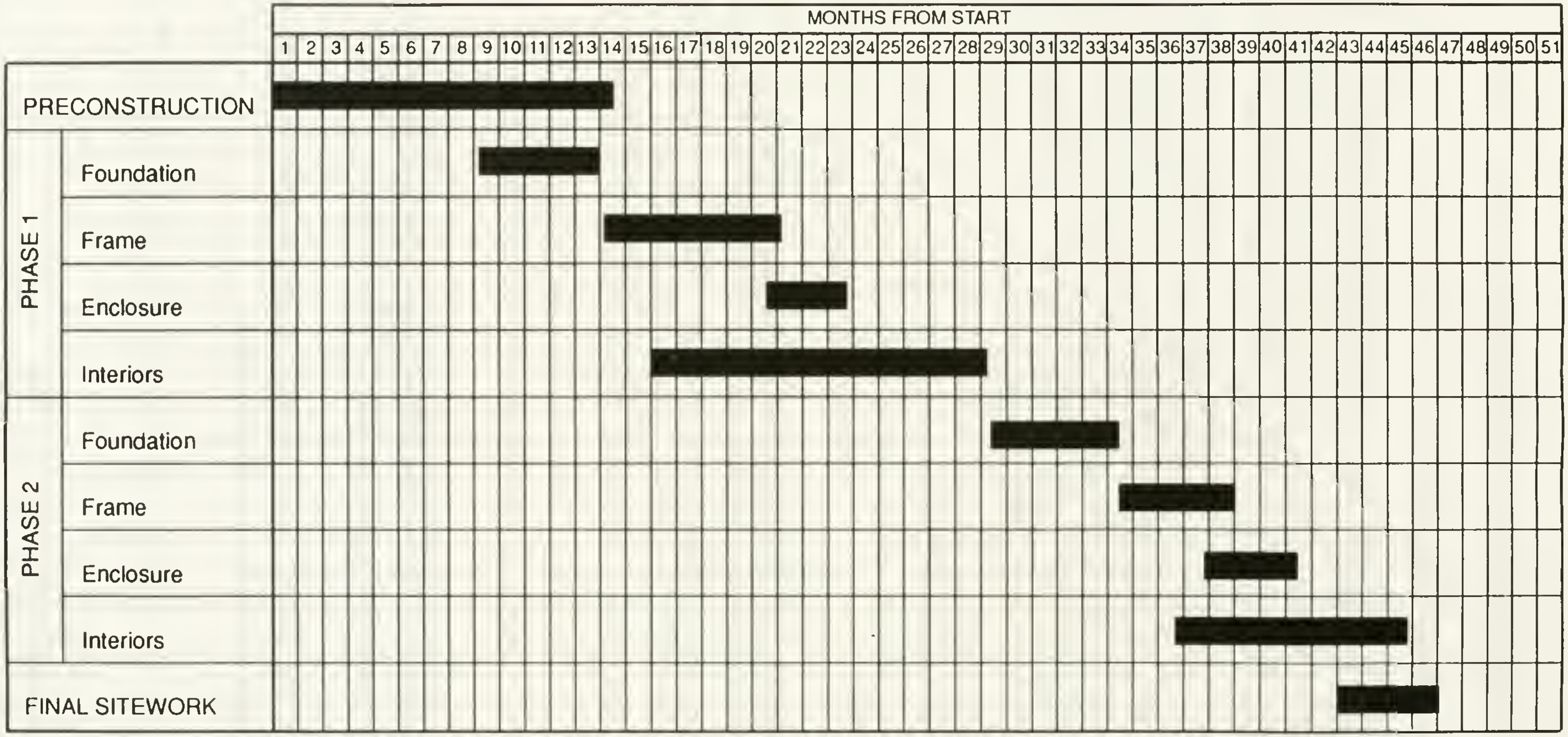


FIGURE V-9.1
PRELIMINARY CONSTRUCTION SCHEDULE

- Locating aggregate storage piles away from areas having the greatest pedestrian activity.
- Monitoring of actual construction practices to ensure that unnecessary transfers and mechanical disturbances of loose materials are minimized.
- Periodic cleaning of streets and sidewalks to minimize dust accumulations.

9.3 Construction Noise

9.3.1 Introduction

Although the project proponent is committed to mitigate impacts of the construction of the Shriners Replacement Facility, increased community sound levels are an inherent consequence of construction activities. The following analysis contains a discussion of the existing noise environment, expected construction activities by phase, and the potential impact of construction noise on existing noise levels. Terminology and metrics used in the analysis are consistent with those described in Section 8.2, Operational Noise. On the basis of this analysis, it can be concluded that the construction noise standards of the City of Boston will be complied with and that construction noise will not interfere with typical daytime activities at the Shriners Burns Institute or neighboring residences or institutions.

9.3.2 Regulatory Requirements and Project Noise Criteria

City of Boston

Regulation 3, "Restrictions on Noise Emitted from Construction Sites" of the Regulations for the Control of Noise in the City of Boston establishes limits for construction noise. A summary of the regulation is provided in Table V-9.1. The regulation limits the maximum noise level to 86 dBA. The L_{10} is limited to 75 dBA. In cases where the ambient L_{10} is above 70 dBA, project related noise is limited to 5 dBA over the ambient. The limits are applied at the lot line of the receiving property. In cases where equipment is operated closer than 50 feet to the applicable lot line, the limits are applied at 50 feet from the equipment. The City of Boston regulations do not apply to impact devices such as pile drivers and jackhammers.

TABLE V-9.1

CITY OF BOSTON
SUMMARY OF CONSTRUCTION SITE NOISE LIMITS

(extracted from Regulation 3, City of Boston Air Pollution Control Commission, Regulations for the Control of Noise in the City of Boston, adopted December 17, 1976.)

NOISE LEVEL LIMITS

Land Use of Affected Property	Noise Level Limit (dBA)	
	L10 level	Maximum Noise Level
Residential or Institutional	75	86
Business or Recreational	80	--
Industrial	85	--

- Measured at the lot line of the affected property.
- The industrial noise limit shall apply to public ways.
- The maximum noise level shall be measured with the sound level meter on "SLOW" response.

EXCEPTIONS

- Measurements should not be taken closer than 50 feet from the nearest active construction device on the site.
- The L10 must exceed the ambient L10 by at least 5 dBA to be considered a violation of the limit.

EXCLUSIONS

- The above limits are not applicable to impact devices such as jackhammers, pile drivers, riveters, pavement breakers, etc.

In addition, different maximum limits apply to heavy motor vehicles such as trucks if they have been sold or leased in the City of Boston. The maximum limit for heavy motor vehicles depends upon their date of manufacture and ranges from 88 dBA at 50 feet for very old trucks to 80 dBA at 50 feet for the newest trucks. These truck limits are applicable anywhere in the City, but they may be superceded by 40 CFR 202 for trucks engaged in interstate commerce.

Environmental Protection Agency (EPA)

EPA's Levels Document* has identified Day-Night levels (L_{dn}) in both indoor and outdoor spaces. The indoor criteria of 45 dBA is based on preventing activity interference. The level is regarded by EPA as a long-term goal, rather than a standard. An indoor construction noise equivalent level (L_{eq}) of 49 dBA would produce EPA's L_{dn} of 45 dBA, based on a daytime 9-hour exposure to construction noise. Most residents of urban areas are exposed to average sound levels higher than the EPA L_{dn} of 45. An indoor L_{eq} of 49 dBA will be used as the criterion for construction noise from non-impact sources as heard inside the existing Shriners Burns Institute.

9.3.3 Existing Environment

A weekday daytime ambient noise survey was conducted in the area around the existing Shriners site. Equipment and methodology used in the survey are consistent with those described in Section 8.3. Four measurement locations were selected to obtain an adequate spatial representation of ambient noise levels. Measurement locations are identified on Figure V-9.2 and are described below along with the measurement conditions.

Conditions for Daytime Ambient Noise Measurements

Time: 11:00 AM to 1:30 PM, Thursday, August 29, 1991
Meteorology: Scattered clouds, 84°F, winds 1-4 mph from the north

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* EPA Report No. 550/9-74-004, Information on Levels of Environmental Noise Requisite to Protect Health and Welfare with an Adequate Margin of Safety, U.S. Environmental Protection Agency, Washington, D.C., 20460, March, 1974.

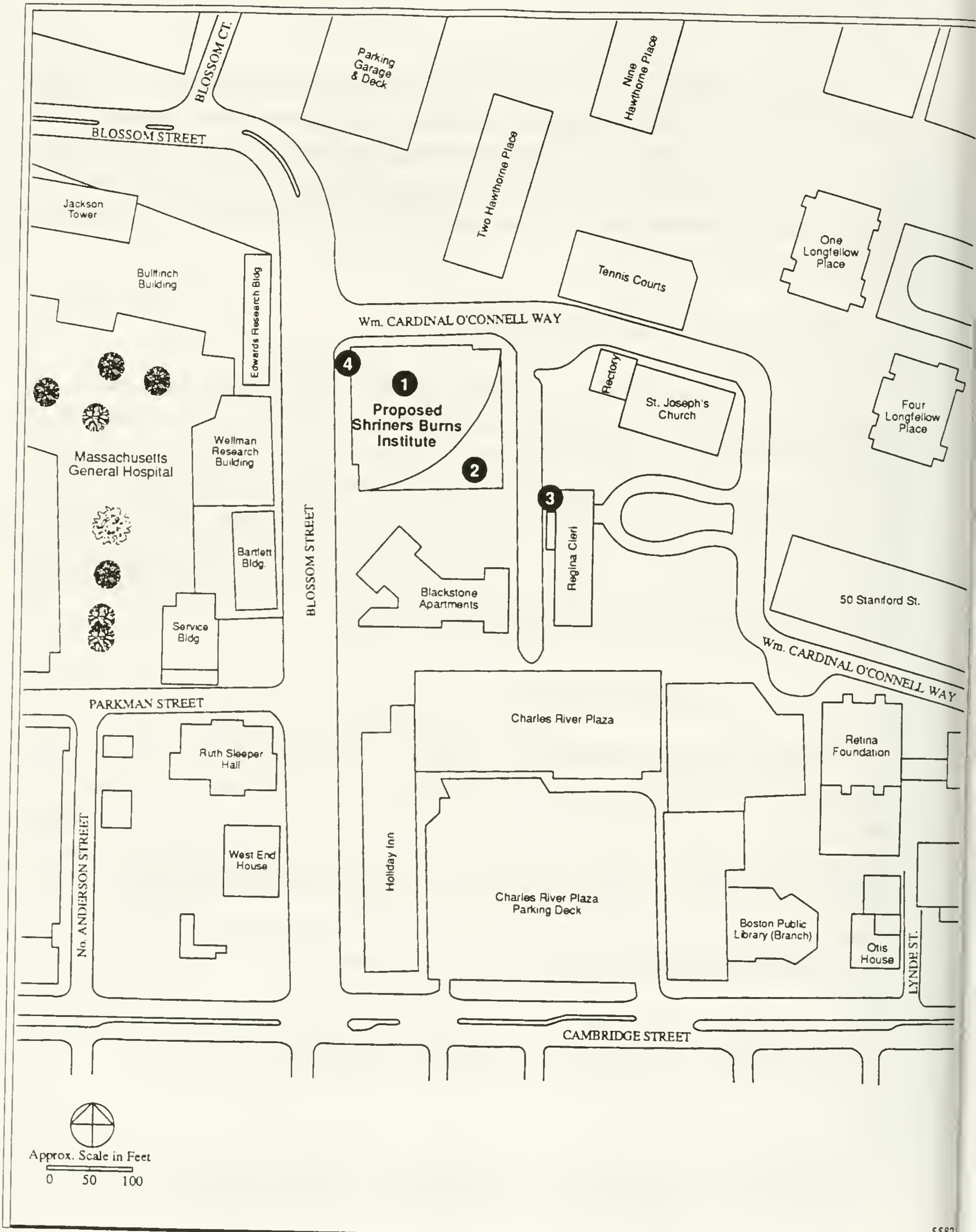

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FIGURE V-9.2
DAYTIME AMBIENT NOISE SURVEY MEASUREMENT LOCATIONS
Shriners Burns Institute

Measurement Locations and Results

Locations 1 and 2 are on the roof of the existing Shriners Burns Institute. Location 1 is near the northwest edge of the roof, overlooking the main entrance. Location 2 is on the auditorium roof near the southeast edge. These two locations correspond to nighttime measurement Locations A and B, also shown in detail on Figure V-8.4. Location 3 is northwest of the Regina Cleri House. It corresponds to nighttime measurement Location C. Location 4 is in the front yard of the existing institute overlooking the intersection of Blossom Street and O'Connell Way.

The results of the daytime ambient noise level survey are provided in Table V-9.2 along with a list of major sources of noise observed during each sampling period. Existing L_{10} levels observed in the area ranged from 62 to 67 dBA. This indicates that the Boston construction noise limit will be 75 dBA because the existing L_{10} levels are all less than 70 dBA.

9.3.4 Construction Noise Sources

The proposed construction process of the new Shriners Burns Institute has been designed especially for the project and site. The initial work will involve the relocation of underground utilities. Augering will then be done to set caissons below grade to support four large columns which will rise outside the existing building to a height above the existing building. Supported on these columns, a new five story building* will be erected immediately above the existing building. Hospital operations will be moved into the new elevated building when it is completed, and the existing building will be demolished.

Piles will be driven or augered around the foundation of the old building so that space can be excavated for a new below-grade parking garage. A building will then be constructed over the parking garage up to the new five-story building above. The final result will be a nine story building in place of the present four-story building, with two and a half levels of below-grade parking (100 cars maximum).

The specific pieces of equipment required for construction have not yet been determined. An interim construction consultant has provided information on the general types of equipment to be used. Based on this information, HMM has assumed the equipment inventory on the site, as a function of construction phase, described in Table V-9.3.

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* Includes the mechanical level within the truss.

TABLE V-9.2
CONSTRUCTION NOISE AMBIENT BASELINE
WEEKDAY DAYTIME SURVEY
Thursday, August 29, 1991

RESIDUAL
OCTAVE BAND ANALYSIS
dB (re: 20 microPascals)

Position Description	Octave band center frequency (Hz) 31.5	63	125	250	500	1000	2000	4000	8000
1 - Roof Northwest	82	80	85	81	77	76	67	58	52
2 - Roof South	65	71	69	65	59	55	50	47	36
3 - Regina Cleri Lot	65	66	64	61	58	51	47	42	40
4 - Front Property Line	69	71	66	64	61	55	50	42	41

AMBIENT NOISE LEVELS
dBA (re: 20 microPascals)

Position Description	Time*	L10	L50	L90	Leq	Noise Sources
1 - Roof Northwest	11:22	67	67	67	67	Mechanical equipment (Wellman, other MGH bldgs, Shriners), traffic (Blossom), distant traffic (Cambridge)
2 - Roof South	12:50	63	62	61	62	Mechanical equipment (Wellman, R.C house, Shriners), traffic, birds, pedestrians, distant construction
3 - Regina Cleri Lot	11:54	62	61	60	61	Mechanical equipment (Wellman, R.C. House, Shriners, Blackstone), traffic (parking lot & local streets)
4 - Front Property Line	11:54	67	64	62	65	Mechanical equipment (Wellman bldg), traffic (Blossom, O'Connell), delivery trucks, pedestrians

* Start time of 10 minute sample (meter was stopped during intrusions of outside noise)

TABLE V-9.3

MAJOR NOISE SOURCES ANTICIPATED DURING THE CONSTRUCTION OF THE SHRINERS HOSPITAL BY CONSTRUCTION PHASE

UTILITY RELOCATION:	jackhammers (exempt) 1 air compressor 1 concrete saw 1 back hoe 1 front-end loader trucks
CAISSONS:	1 large crane 1 earth auger 1 front-end loader concrete trucks trucks
STEEL ERECTION (UPPER LEVEL):	2 large cranes 1 fork lift truck 2 diesel generators 1 concrete pump 1 air compressor concrete trucks trucks
SIDING (UPPER LEVEL):	1 mortar mixer 1 fork lift 2 cranes trucks
INTERIOR FINISHING (UPPER LEVEL):	trucks
DEMOLITION AND SOIL RETENTION:	1 large crane 1 auger or 1 pile driver (exempt) 2 front-end loaders trucks
STEEL ERECTION (LOWER LEVEL):	2 large cranes 1 fork lift truck 2 diesel generators 1 concrete pump 1 air compressor concrete trucks trucks
SIDING (LOWER LEVEL)	1 mortar mixer 1 fork lift 2 cranes trucks
INTERIOR FINISHING (LOWER LEVEL):	trucks

9.3.5 Construction Noise Estimates

Construction of the new Shriners Burns Institute will occur during the daytime, defined by the Boston Noise Regulation as between 7:00 AM and 6:00 PM except Sunday. It is expected, however, that construction will occur between 7:00 AM and 3:30 PM Monday through Friday.

The following analysis shows that the noise limits of Boston's Regulation 3 are likely to be met by equipment on the site performing construction activities. It is assumed that heavy trucks and concrete mixers serving the site from the public ways will comply with Boston's Regulation 4, or with 40 CFR 202 as applicable.

The City of Boston construction noise regulations are applied at the receiving lot line or at 50 feet, whichever is further. Because of the small size of the Shriners site, it is likely that some construction equipment will operate less than 50 feet from the lot line, although some will be further than 50 feet. Since noise levels decrease with distance, the 50-foot distance represents the most restrictive application of the limit. All construction equipment estimates in this study are analysed at a distance of 50 feet. The noise contribution of more distant equipment will be less than the estimates provided here.

Maximum Noise Levels Outdoors

The maximum noise levels typically produced by each of the major items of equipment listed in Table V-9.3 are shown in Table V-9.4. Because almost all construction equipment operates intermittently, some will not be on the site throughout the construction process, and some will be further than fifty feet from the lot line; the combined maximum levels listed in the last column are each considered to be reasonable estimates of the maximum noise which will be produced by construction activities on the site. As shown on the table, all of the estimates are below the 86 dBA Maximum level limit of Boston's Regulation 3 (see Table V-9.1).

L10 Noise Levels Outdoors

Almost all construction equipment operates intermittently. Equipment is sometimes unenergized but kept on site for use when necessary. Even when operating, construction equipment may be idling or otherwise not producing its highest noise levels.

TABLE V-9.4

MAXIMUM NOISE LEVELS OF CONSTRUCTION EQUIPMENT EXPECTED TO BE USED (AT 50 FEET)

Equipment	Max Level dBA @ 50 ft	Data source (Below)	*No. of pieces on site	Combined Max. Level dBA @ 50 ft
Large cranes (20 ton)	81	2	2	84
Air compressor (125 HP)	81	2	1	81
Concrete saw	78	1	1	78
Back hoe	83	2	1	83
Front-end loader	79	1	2	82
Earth auger	< 80	3	1	80
Fork lift	< 80	3	1	80
Generators (50 kw)	79	2	2	82
Concrete pump (220 cy/h)	81	2	1	84
Mortar mixer	85	1	1	85

DATA SOURCES:

1. USEPA, Noise From Construction Equipment and Operations, Building Equipment, and Home Appliances, NTID300.1, December, 1971.

2. Bolt Beranek and Newman, Power Plant Construction Noise Guide, Report 3321, May 1977.

3. Estimated: no data found in the literature. This suggests that these have not been found to be major construction noise sources.

* Adustment is 10Log [number of items]

A procedure for estimating L10 noise levels from construction sites is given in Bolt Beranek and Newman, Power Plant Construction Noise Guide, Report 3321, May, 1977. It starts with the maximum noise level from each item of equipment on the site during a specific construction phase. These levels are adjusted by "usage factors" for the percentage of time that each item of equipment is typically active during the phase; and by "max factors" representing the percentage of time that an item of equipment typically produces its maximum noise level when active. The result is an equivalent noise level for each item of equipment. These can be summed for all equipment in use during a construction phase to obtain the equivalent level for that phase. Experience has shown that the L10 level is typically 2 dBA greater than the equivalent level. This procedure is shown in Tables V-9.5 and V-9.6 for the construction phases of the Shriners Burns Institute.

The estimates in Tables V-9.5 and V-9.6 indicate that the total equivalent noise levels for each construction phase will be less than or equal to 73 dBA. Applying the +2 dBA adjustment for the difference between the equivalent level and the L10 level, it is estimated that the 75 dBA L10 limit established by Boston's Noise Regulation will be complied with.

Indoor Equivalent Noise Levels

The existing Shriners Burns Institute will remain in operation during the construction of the new five story building above the existing structure. Noise levels from construction activities will be reduced in interior spaces by the building enclosure. The building is made of brick and has sealed windows that can be opened only with a special tool. Due to climate control requirements of the burn patients, the windows are not routinely opened. Actual construction noise impacts to the patients should be less than indicated here since all patient sleeping areas have brick walls with no windows.

Measurements were made at the existing structure to identify the noise reduction performance of the structure. A tour of the facility was conducted to identify a location within the building which was suitable for such measurements. A second floor research office overlooking the front entrance was selected. The acoustic environment in the room, when closed, had minimal internal building noise and was dominated by a steady outside noise source. The noise source was, in this case, a cooling tower on the MGH Edwards Research Building. The measurements were made with the same equipment and methodology as is described in Section 8.3.2.

TABLE V-9.5
ESTIMATES OF Leq LEVELS DURING UPPER LEVEL CONSTRUCTION BY CONSTRUCTION PHASE (AT 50 FEET)

Utility relocation:

Noise source	Max. level	*Usage factor	**Max. factor	***No. of items	Total
jackhammers (exempt)	(exempt)	n/a	n/a	n/a	n/a
air compressor	81 dBA	-6 dBA	-7 dBA	1	68 dBA
concrete saw	78	-6	-6	1	66
back hoe	83	-10	-4	1	69
front-end loader	79	-10	-5	1	64
TOTAL FOR PHASE					73 dBA

Caissons:

Noise source	Max. level	*Usage factor	**Max. factor	***No. of items	Total
large crane	81 dBA	-10 dBA	-13 dBA	1	58 dBA
earth auger	80	-6	-6	1	68
front-end loader	79	-10	-5	1	64
TOTAL FOR PHASE					70 dBA

Steel erection (upper level):

Noise source	Max. level	*Usage factor	**Max. factor	***No. of items	Total
large cranes	81 dBA	-10 dBA	-13 dBA	2	61 dBA
fork lift truck	80	-10	-6	1	64
diesel generators	79	-6	-7	2	69
concrete pump	81	-10	-7	1	64
air compressor	81	-6	-7	1	68
TOTAL FOR PHASE					73 dBA

Siding (upper level):

Noise source	Max. level	*Usage factor	**Max. factor	***No. of items	Total
mortar mixer	85 dBA	-10 dBA	-8 dBA	1	67 dBA
fork lift	80	-10	-6	1	64
cranes	81	-10	-13	2	61
TOTAL FOR PHASE					69 dBA

Interior finishing (upper level):

No major outdoor equipment expected

Notes:

* Estimated, with assistance from Tables A-1 and A-2 of USEPA, Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances, NTID300.1, December, 1971.

** From Table B.5 of Bolt Beranek and Newman, Power Plant Construction Noise Guide, Report 3323, May, 1977. Some values, not given in this source, are estimated.

*** Adustment is 10 Log [number of items]

TABLE V-9.6

ESTIMATES OF Leq LEVELS DURING LOWER LEVEL CONSTRUCTION BY CONSTRUCTION PHASE (AT 50 FEET)

Demolition and soil retention:

Noise source	Max. level	*Usage factor	**Max. factor	***No. of items	Total
large crane	81 dBA	-10 dBA	-13 dBA	1	58 dBA
auger	80	-6	-6	1	68
front-end loaders	79	-10	-5	2	67
		TOTAL FOR PHASE			71 dBA

Steel erection (lower level):

Noise source	Max. level	*Usage factor	**Max. factor	***No. of items	Total
large cranes	81 dBA	-10 dBA	-13 dBA	2	61 dBA
fork lift truck	80	-10	-6	1	64
diesel generators	79	-6	-7	2	69
concrete pump	81	-10	-7	1	64
air compressor	81	-6	-7	1	68
		TOTAL FOR PHASE			73 dBA

Siding (lower level):

Noise source	Max. level	*Usage factor	**Max. factor	***No. of items	Total
1 mortar mixer	85 dBA	-10 dBA	-8 dBA	1	67 dBA
1 fork lift	80	-10	-6	1	64
2 cranes	81	-10	-13	2	61
		TOTAL FOR PHASE			69 dBA

Interior finishing (lower level):

No major outdoor equipment expected

Notes:

* Estimated, with assistance from Tables A-1 and A-2 of USEPA, Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances, NTID300.1, December, 1971.

** From Table B.5 of Bolt Beranek and Newman, Power Plant Construction Noise Guide, Report 3323, May, 1977. Some values, not given in this source, are estimated.

*** Adustment is 10 Log [number of items]

Two residual octave band analyses were performed at different locations within the interior office space with the windows closed. Another residual octave band analysis was performed with the microphone outside the window, extended eight feet from the wall to minimize reflection effects. The results of the measurements are presented graphically on Figure V-9.3. The difference between the measured spectra is the outdoor to indoor noise reduction for interior spaces. Note that the inside spectrum was adjusted within the higher frequency bands. This part of the spectrum was estimated since the observed noise levels were below the measurement threshhold of the meter.

The building noise reduction value was then subtracted from the predicted construction equipment noise levels taken from Table V-9.6 to determine the construction noise impact on interior spaces. The spectrum shape for diesel engines was used in the analysis of noise from each type of construction equipment. The subtraction procedure was applied within each octave band and the resulting spectra were A-weighted. The maximum indoor equivalent levels are as follows:

Utility Relocation	47 dBA
Caissons	44 dBA
Steel Erection	47 dBA
Siding	43 dBA

9.3.6 Conclusions

The noise levels from the operation of construction equipment are highly variable. The City of Boston Noise Regulation limits the maximum noise levels from regulated construction equipment to 86 dBA. Based on maximum noise levels of individual pieces of operating equipment and the number of pieces expected on the site, the maximum levels at the point where the regulations apply are expected to range from 78 dBA to 85 dBA. The results indicate that the project will comply with maximum noise level limits.

The results of weekday daytime ambient noise measurements show that existing L_{10} levels are below 70 dBA during construction hours. Based on the City of Boston Noise regulation, the L_{10} limit for regulated construction equipment is, therefore, 75 dBA. The L_{10} level was estimated for each phase of construction, based on the type, number and usage of individual pieces of equipment. The L_{eq} levels ranged from 69 dBA to 73 dBA and the L_{10} levels are expected to be 71 dBA to 75 dBA. Therefore, the construction of the Shriners Replacement Facility is expected to comply with the L_{10} level limit.

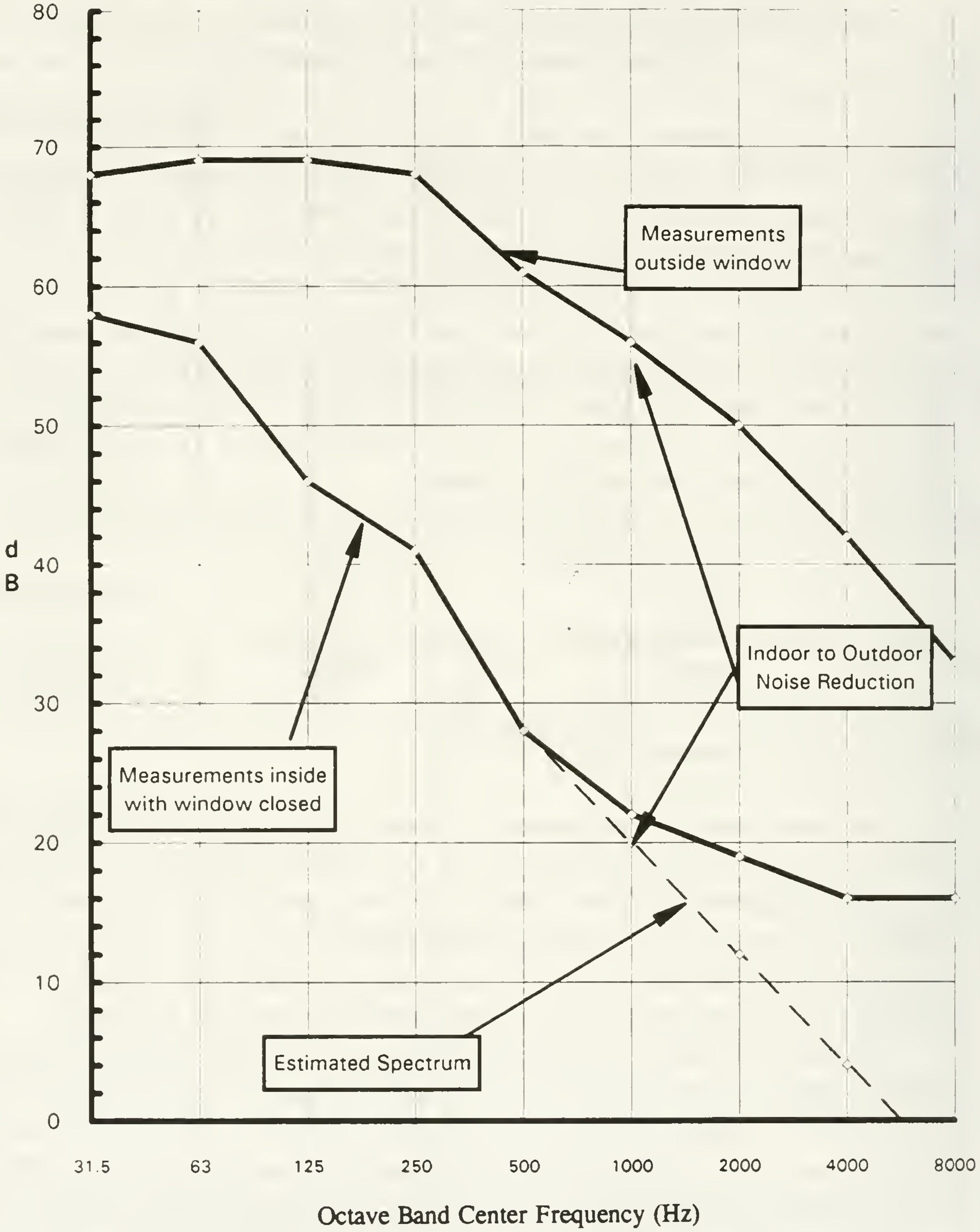


FIGURE V-9.3
OUTDOOR TO INDOOR NOISE REDUCTION

The noise impact from construction activities was evaluated at Shriners Burns Institute patient residence areas. The analysis used a project criteria of 49 dBA which is based on EPA recommended levels for indoor spaces. Estimated noise levels from construction activities were reduced by the measured noise reduction performance of the building envelope of the Shriners Burns Institute. Interior noise levels are estimated to range from 43 dBA to 47 dBA for the various phases of construction. Because of increased distances, impacts at indoor spaces of other institutional and residential buildings are anticipated to be less. The results indicate that the construction of the Shriners Replacement Facility will not result in excessive activity interference for residents of the Shriners Burns Institute or neighboring residences or institutions.

9.4 Construction Staging Areas

In determining scheduling, truck routes, and staging locations for the proposed Shriners Burns Institute, particular attention will be given to ensure the protection of nearby residential buildings, hospital buildings, and the St. Joseph's Church. Each stage of construction will have minor truck and pedestrian traffic impacts.

Shriners Burns Institute will negotiate and sign a Construction Management Plan (CMP) with the Boston Transportation Department (BTD) for approval prior to the start of construction. The CMP includes specific mitigation measures and staging plans to minimize impacts to the abutters. The first meeting in this process was held with BTD on February 7, 1992.

The proposed staging plan is designed to isolate the construction while providing safe access for pedestrians and automobiles during normal day-to-day activity and emergencies. A detailed construction plan will be included in the Traffic Maintenance Plan in compliance with the City's Construction Management Program as required by the Boston Transportation Department (BTD) prior to construction.

The following paragraphs include a description of the proposed staging locations and provisions for delivery and storage of construction materials and equipment.

Figure V-9.4 illustrates the materials staging area. Construction staging requires the closing of the northbound side of Blossom Street in front of the hospital which will be used as an assembly area for steel, concrete, and brick. The use of Blossom Street for staging will only be required during Phase I. During Phase II construction, it is anticipated that staging will be located on-site. During Phase I, northbound traffic will be diverted onto the southbound side of the street between the Blackstone Building and William Cardinal O'Connell Way. If necessary, a police detail will be assigned to direct traffic. The detour will require the removal of the six parking meters located on the northbound side of the street, and 18 spaces along the south side of the street in front of Massachusetts General Hospital (MGH). Monetary reimbursement to the City of Boston for lost parking revenues will be paid by Shriners based on the City's formula for estimating revenues.

9.5 Perimeter Protection/Public Safety

An illuminated covered pedestrian walkway will be provided across Blossom Street and along William Cardinal O'Connell Way, as shown on Figure V-9.4. The covered walkway will allow pedestrians walking on the sidewalk near MGH to safely cross Blossom Street and walk along William Cardinal O'Connell Way to the proposed Shriners Burns Institute or beyond. The pedestrian cross-overs will have appropriate signage, demarcation, and barricades to ensure safety. Police office control will also be provided as necessary to assure pedestrian safety.

During construction, the perimeter of the project site will be fenced to provide security for equipment and to ensure the safety of passers by. Once installed, the fence will be modified as necessary depending on construction activity. The project safety officer will constantly monitor the perimeter protection to ensure that during nonwork hours the general public cannot accidentally enter a restricted area. Temporary fire exits from the existing hospital site will be maintained in an emergency condition.

9.6 Truck Routes and Volumes

As also described in the Transportation Access Plan Component, trucks will be needed to remove material excavated from the site and to deliver construction materials to the site. Truck traffic will vary throughout the construction period, depending on the activity. The volumes described below are estimates and may be refined as the construction schedule becomes finalized.

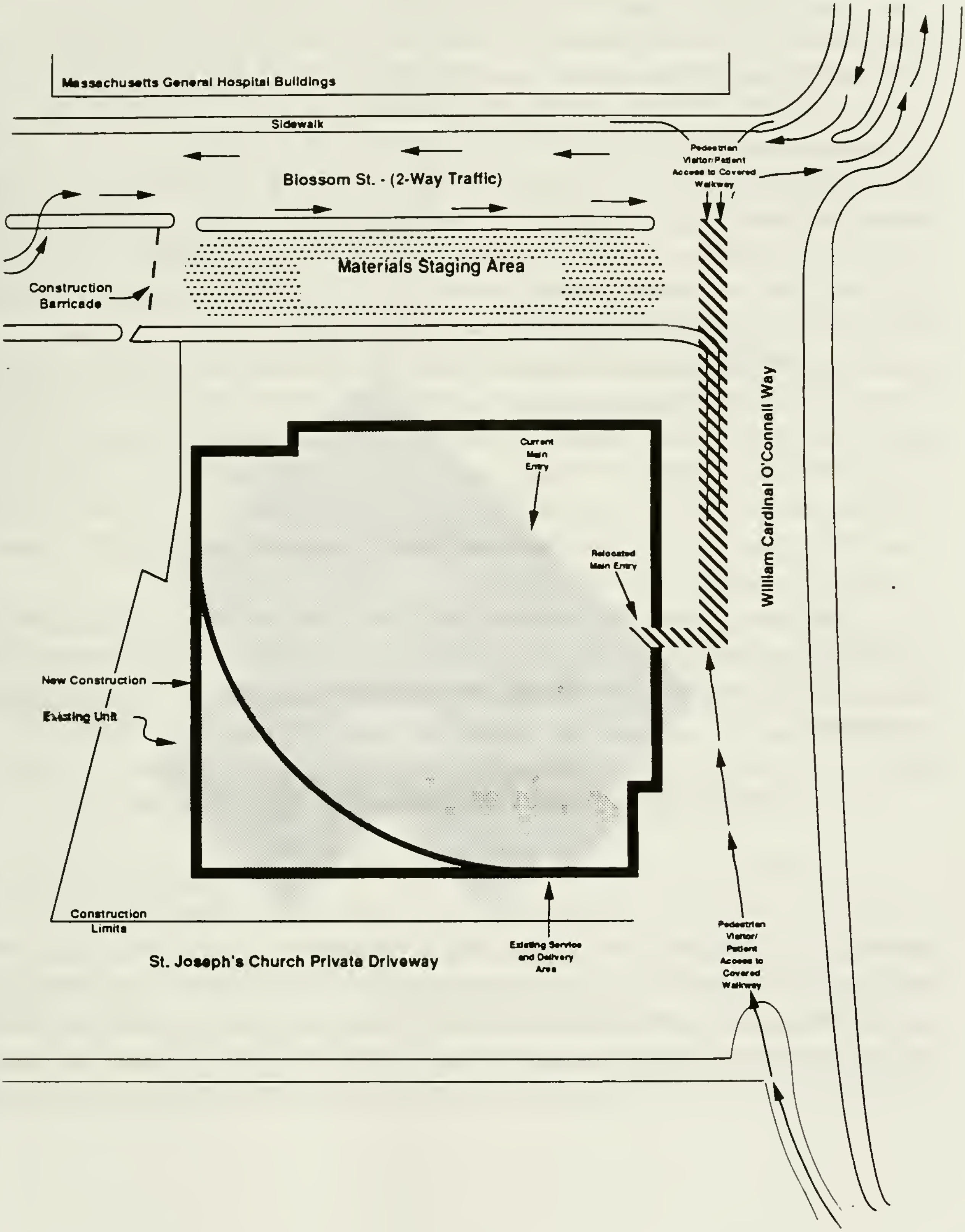

Massachusetts General Hospital Buildings
Sidewalk
Pedestrian Visitor/Patient Access to Covered Walkway
Blossom St. - (2-Way Traffic)
Materials Staging Area
Construction Barricade
William Cardinal O'Connell Way
Current Main Entry
Relocated Main Entry
New Construction
Existing Unit
Construction Limits
St. Joseph's Church Private Driveway
Existing Service and Delivery Area
Pedestrian Visitor/ Patient Access to Covered Walkway

FIGURE V-9.4
STAGING

At the present time, Shriners Burns Institute does not know the geographical distribution of truck deliveries. As a result, a comprehensive plan to handle trucking activity from any direction cannot be developed. In general, trucks from the south and west are expected to exit the Central Artery (Route I-93) at the North Station exit. These construction vehicles will proceed immediately to the site via Causeway Street, Staniford Street, Cambridge Street, and Blossom Street. Vehicles arriving from the north along either the Tobin Bridge or I-93 will exit onto Storrow Drive. These vehicles will arrive at the site via Cambridge and Blossom Streets from Charles Circle. Vehicles exiting the site will most likely be directed toward Leverett Circle and the I-93 on-ramp. Construction vehicles will not be permitted to use William Cardinal O'Connell Way.

The number of trucks during the construction period will vary. On average, over the course of the demolition and construction phase, truck volumes of five to ten arrivals and five to ten departures per workday are expected. The peak volume of construction trucks will occur during concrete pouring. At that time, 20 to 25 arrivals and departures per workday are expected. Assuming an even distribution over an eight-hour day, this translates to approximately six arrivals and departures per hour. The traffic impacts of these trips is expected to be negligible.

Limiting the impacts of construction traffic and truck noise on the adjacent buildings were the most important factors in determining the truck routes. Enforcement of truck routes will be accomplished through clauses in the contractors' and subcontractors' agreements.

9.7 Employee Trip Generation and Construction Worker Parking

As described in the Transportation Component, the number of workers required during the construction period will vary, with an estimated average daily work force of approximately 200 workers during the peak of construction. Assuming the daily modal split identified in Table IV-3.2, the maximum of 200 workers translates to an estimated 105 vehicle trips arriving between 6:00 and 7:00 AM and departing between 3:00 and 4:00 PM. As the construction workers usually arrive and depart before the commuter peak hours, the construction traffic is not expected to have a significant impact on the peak hour traffic.

Construction workers will be encouraged to use public transportation. Ample secured storage for tools will be provided on-site so that workers will not need to transport their tools to and from the site on a daily basis which will alleviate the need to drive to the site.

In order to discourage driving to the site, no on-site parking will be available for personal vehicles. Past experience shows that the lack of free or subsidized parking discourages use of personal vehicles and increases carpooling. Construction workers who do drive will utilize off-street commercial parking spaces. Given their projected time of arrival, such spaces should be available.

Construction workers will be encouraged to utilize the MBTA. Each construction worker who agrees to commute to the job site via public transportation for a full calendar month will be offered an MBTA pass for that month at a discount.

In addition, bulletin boards located around the site will be used to post bus schedules, train schedules, and carpooling information.

9.8 Groundwater

Section 6.0, the Geotechnical Analysis, includes a more detailed description of the foundation construction procedures and mitigation measures concerning groundwater impacts. Groundwater observation wells will be installed around the perimeter of the site to allow the Geotechnical Engineer to monitor the groundwater levels during the construction period to ensure that groundwater levels are maintained prior to, during, and after construction.

9.9 Demolition

As described previously, demolition of the existing Shriners Burns Institute will not occur until the occupants of the existing building are moved in to the new space built above the existing building. In order to minimize impacts to the occupants in the space above the existing building, extreme care will be required not to disturb any new footings or structural members.

The existing building will be manually severed into small pieces by laborers with small power tools and basically picked apart to minimize transmission of noise and vibration while individual sections are being removed. A structural engineer will review the method and overall plan to insure a safe operation. Extreme care will be required to insure all existing utilities to the existing building have been disconnected to avoid any possibility of fire or accidents. Utility connections to the addition will, of course, be in operation. To contain dust, large quantities of water will be required to constantly spray and saturate the demolished building parts. Pumps with filters will be employed to remove excess water and eliminate the possibility of silt or sludge from being deposited into the stormwater system. Water containment will be a major concern so that runoff will not disrupt adjacent neighbors. A saturated filtering net suspended from the structure above and around various sections of the demolition will be investigated to minimize noise and dust.

Debris will be loaded into trucks by a skilled operator using a hydraulic claw hoe, which has the ability to precisely pick up and maneuver debris materials.

As described in the Solid and Hazardous Waste Analysis, Section 7.0, the bulk of the construction debris will consist of non-contaminated steel, metal, wood, brick, and roofing material. Some of the steel, wood, and metal may be salvaged, and the rest will be removed by the contractor. The waste will be disposed of in an approved landfill under the authority of the contractor. To prevent the accumulation of debris on-site, disposal of debris will be carried out while the demolition is occurring. The naming of specific sites for disposal is premature at this time since conditions and available disposal sites may change by the time construction begins. The demolition contractor will, however, assume full responsibility for disposing the debris efficiently and appropriately in accordance with applicable regulations.

10.0 RODENT CONTROL ANALYSIS

The City of Boston has declared that the infestation of rodents in the City is a serious problem. In order to control this infestation, the City has established requirements under the Massachusetts State Sanitary Code, Chapter II, 105 CMR 410.550 and the State Building Code, Section 108.6. Policy Number 87-4 establishes that extermination of rodents shall be required for issuance of permits for demolition, excavation, foundation, and basement rehabilitation. Based on discussions with the Inspectional Services Division, there are no known problems in the Blossom Street/Massachusetts General Hospital area.

Presently, the Shriners Burns Institute has an active pest control program. The program provides for weekly extermination of the interior and exterior of the current Institute. Licensed and certified pest control operators carry out the weekly inspection and extermination if necessary. Upon completion of the proposed project, the rodent control program will be updated and expanded to accommodate the proposed Shriners Burns Institute. In addition, prior to any demolition or construction, the construction contractor will initiate a rodent control program.

A rodent extermination certificate will be filed with the building permit application to the City. Rodent inspection monitoring and treatment will be carried out before, during, and at the completion of all foundation work for the proposed project, in compliance with the City's requirements. Rodent extermination prior to work start-up will consist of treatment of areas throughout the project area, including alleyways, surrounding building exteriors, and building interiors. Any off-site rodent control measures will only be implemented with the prior approval of the appropriate landowners. During the construction process, regular service visits will be made in order to maintain effective rodent control levels.

VI. Urban Design Component

VI. URBAN DESIGN COMPONENT

1.0 INTRODUCTION / PROJECT ALTERNATIVES

1.1 Site Location

The proposed Shriners Burns Institute is located on the existing Burns Institute site (see Figure VI-1.1). The block is bounded on the north by William Cardinal O'Connell Way and on the west by Blossom Street. Adjacent facilities include St. Joseph's Catholic Church and Regina Cleri (elderly priest's housing) to the east, the Blackstone (elderly housing) to the south, Charles River Park (mid and high rise residential) to the north, and Massachusetts General Hospital to the west. The facilities of Massachusetts General Hospital directly across Blossom Street include the Wellman Research Building, the Edwards Research Building and Bartlett Hall.

1.2 Project Program

1.2.1 Building Program

The proposed Burns Institute consists of 200,000 gross square feet of medical space. 70,000 gross square feet of below-grade parking is proposed. The Shriners are negotiating for 100 spaces on-site. The new facility is to provide a Replacement Facility for the existing facility constructed in the late 1960's. Acute Care and Reconstruction are the primary inpatient functions. Outpatient care will be expanded as will other support functions, which are currently cramped in the existing building. Research, which is currently being moved off-site due to space limitations, will be returned to the new facility upon completion. The Boston Shriners project is one of three replacement facilities being completed by Shriners in the United States. It is the smallest of the three Burns Institutes - including Cincinnati, Ohio and Galveston, Texas.

1.2.2 Phased Construction

After exploring alternate sites, the Shriners determined that building on their existing site was the best option. Building on-site allows the hospital to maintain its physical link (through an existing tunnel) with Massachusetts General Hospital, which is important to ensure the best care to the patients of the Shriners Burns Institute and

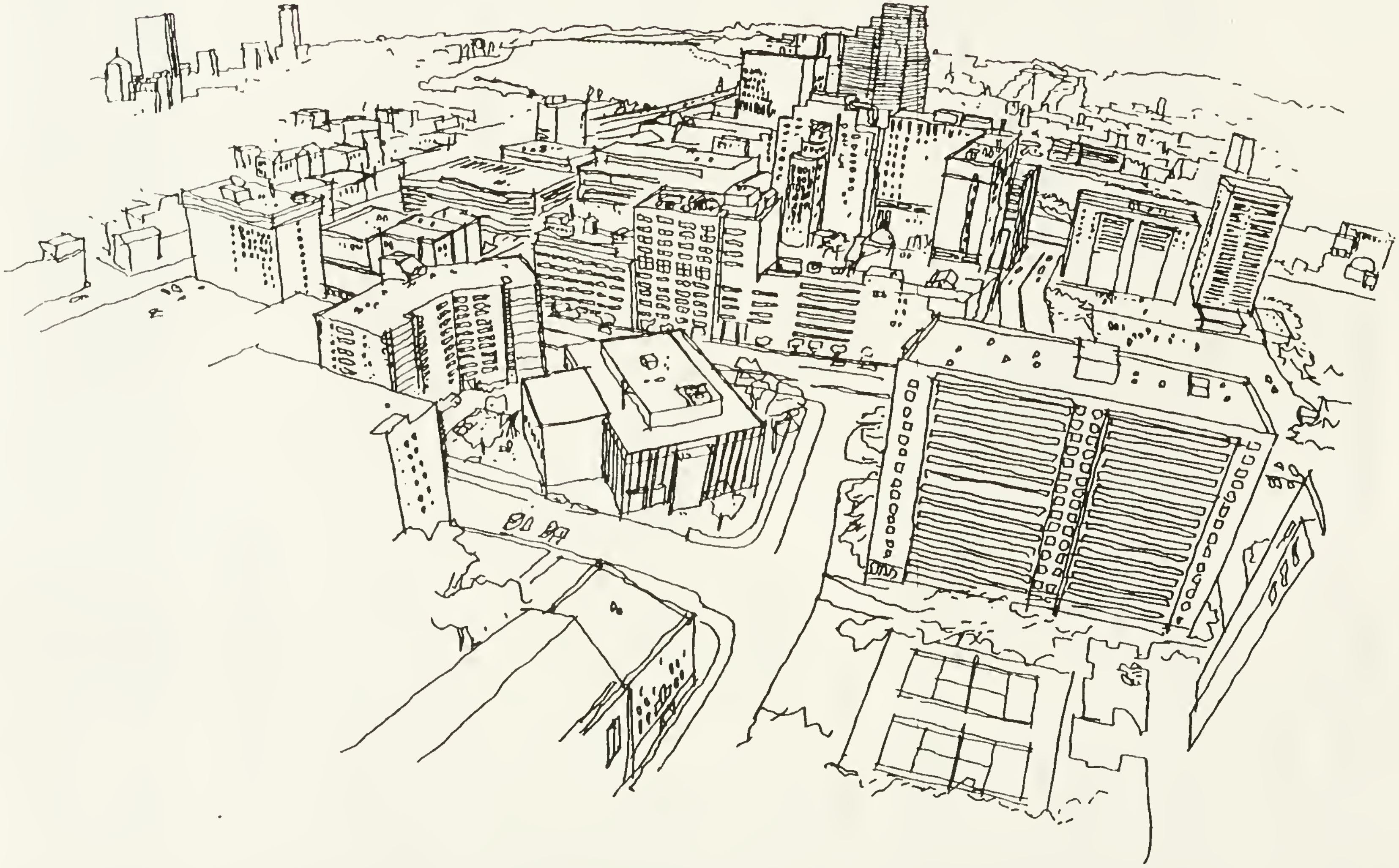


FIGURE VI - 1.1
RENDERING OF EXISTING SITE

Massachusetts General Hospital. Many of the doctors at MGH and Shriners have joint affiliations with the two hospitals. In addition, patients are often transferred back and forth between the hospitals.

Building on the existing site is accomplished in two phases. Phase I involves construction of a series of steel trusses over the existing building, which will support the four levels above. Normal operations are maintained in the existing facility while construction above is underway. Upon completion of Phase I, patients and staff will move into the upper levels and Phase II will begin. Phase II includes demolition of the existing facility and construction of four levels of hospital functions, and two and a half levels of below grade parking (100 cars maximum).

1.3 Project Alternatives/Modifications

The original Project Notification Form, submitted to the Boston Redevelopment Authority on March 14, 1991, described a 200,000 gross square foot project with above grade parking for 150 cars. Five levels were to be built above the truss (155,000 gross square feet in Phase I), and two levels of hospital functions (45,000 gross square feet) and parking levels (above grade) were to follow in Phase II (see Figures VI-1.2 and VI-1.3).

The height of the building was 155 feet, the maximum permissible in the IPOD District. A roof terrace/play area was proposed for the southeast corner of the 10th floor and an automobile drop off was located along William Cardinal O'Connell Way. Entrances and exits from the parking levels were located on William Cardinal O'Connell Way, as well as the service entrance, which made use of an existing easement with the Archdiocese.

A series of neighborhood meetings followed the PNF submittal which led to the redesign of the proposed scheme. A description of the meetings is included in Section II, General Information.

The current proposed project is a nine-story structure with 2½ levels of below-grade parking. (There have been negotiations to reduce total on-site spaces to 100 cars.) Four levels occur above the truss level and four below the truss level (see Figures VI-1.4 through VI-1.6). Mechanical equipment is housed at the truss level. Early discussions with the Boston Redevelopment Authority indicated a desire to establish the "street wall" which had been lost over the years. The south and east sides of the project are curved above the second floor, to allow views from the Blackstone and Regina Cleri Buildings,

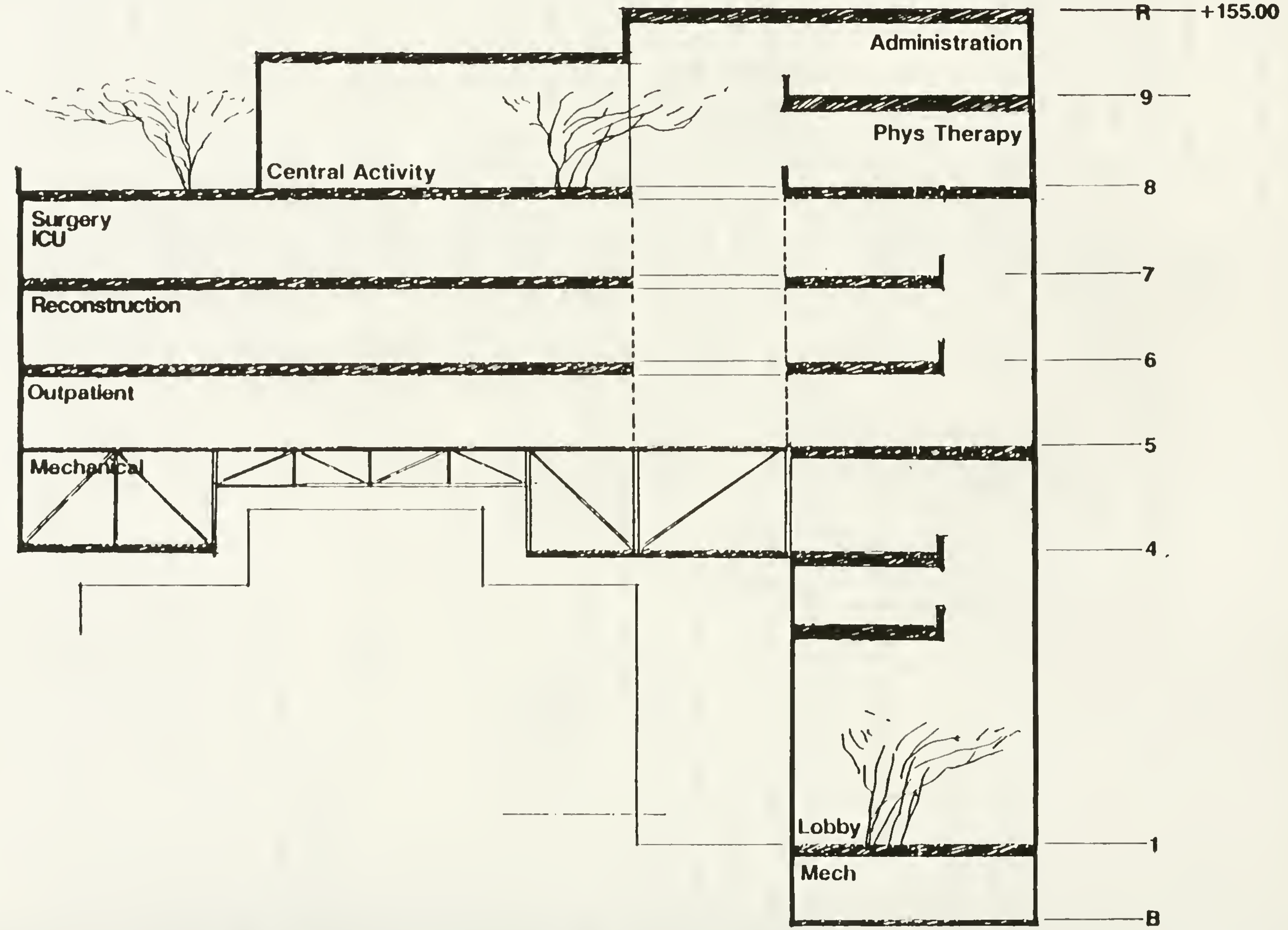


FIGURE VI-1.2
ORIGINAL PHASE I BUILDING SECTION, MARCH 1991
SHRINERS REPLACEMENT FACILITY

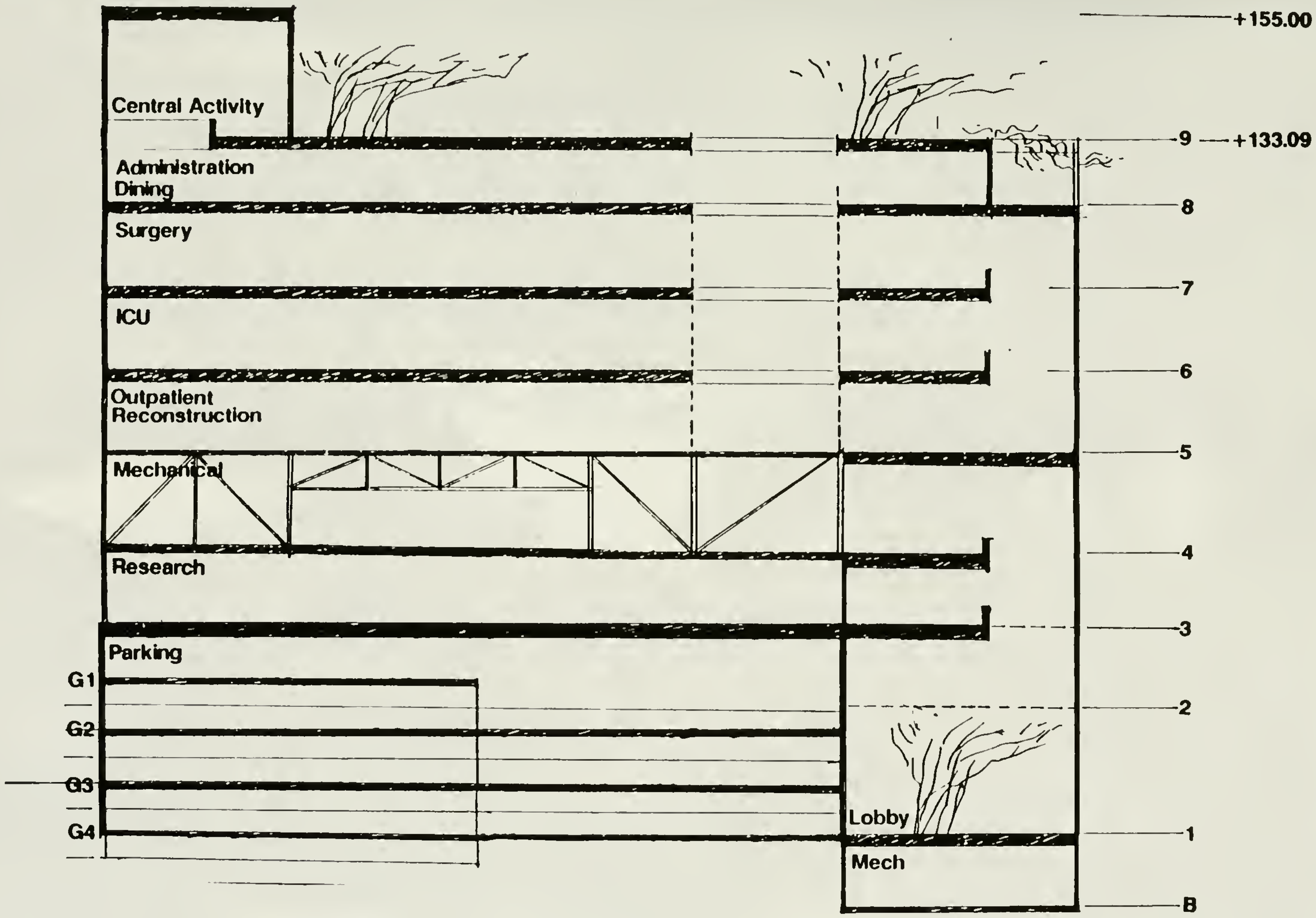


FIGURE VI-1.3
ORIGINAL PHASE II BUILDING SECTION
SHRINERS REPLACEMENT FACILITY

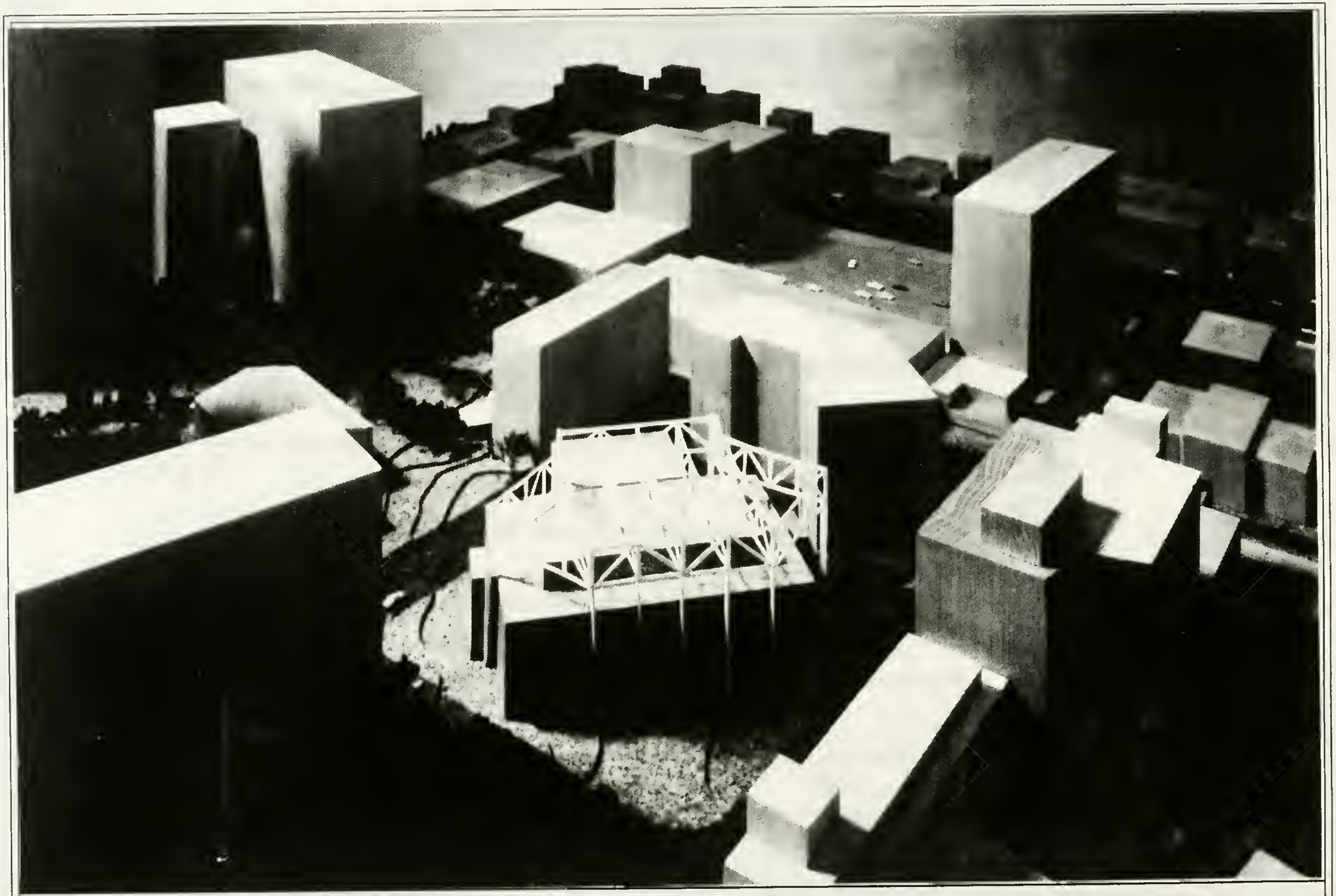


FIGURE VI-1.4
TRUSS ABOVE EXISTING BUILDING

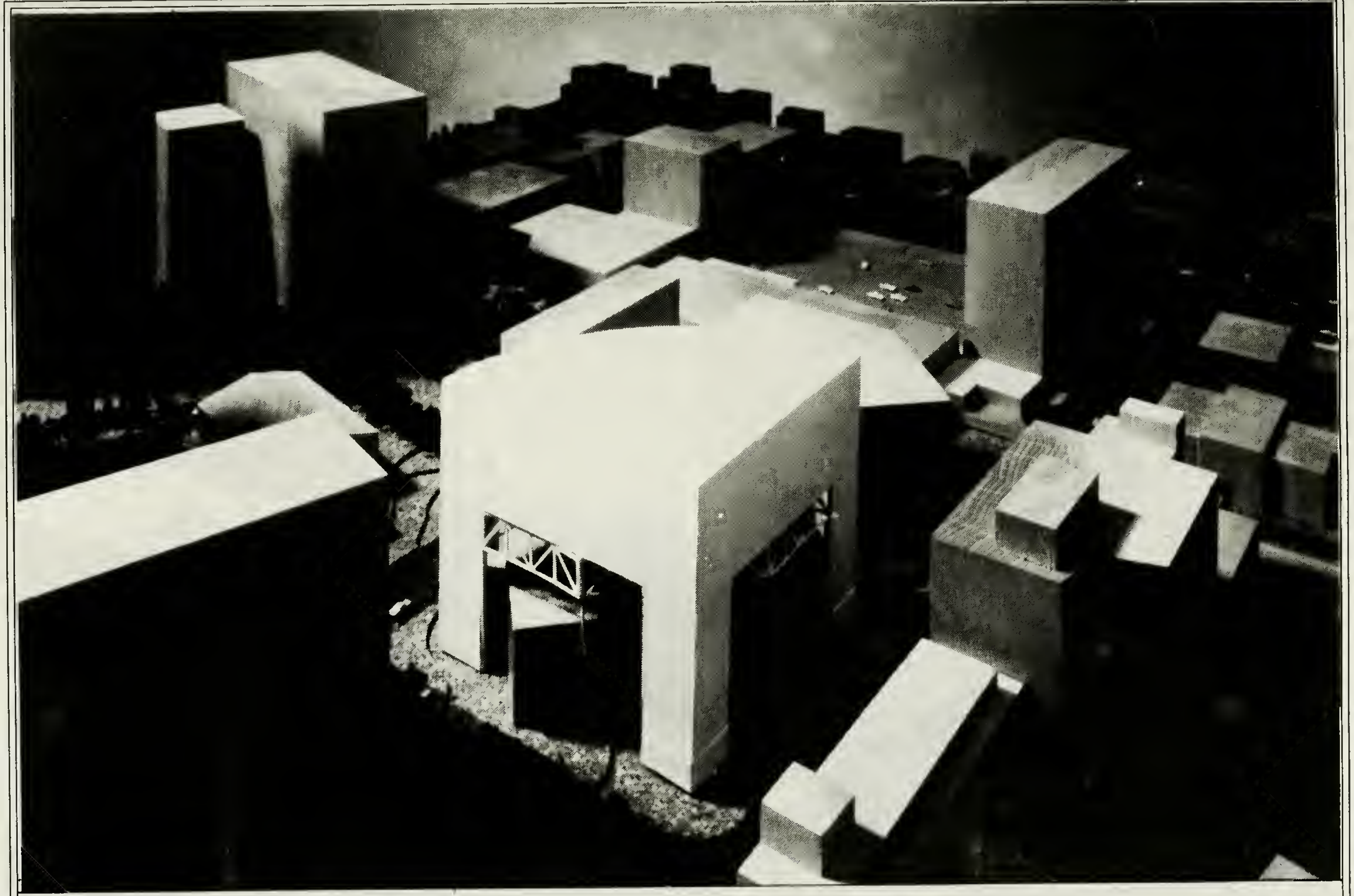


FIGURE VI-1.5
PHASE I CONSTRUCTION ABOVE TRUSS

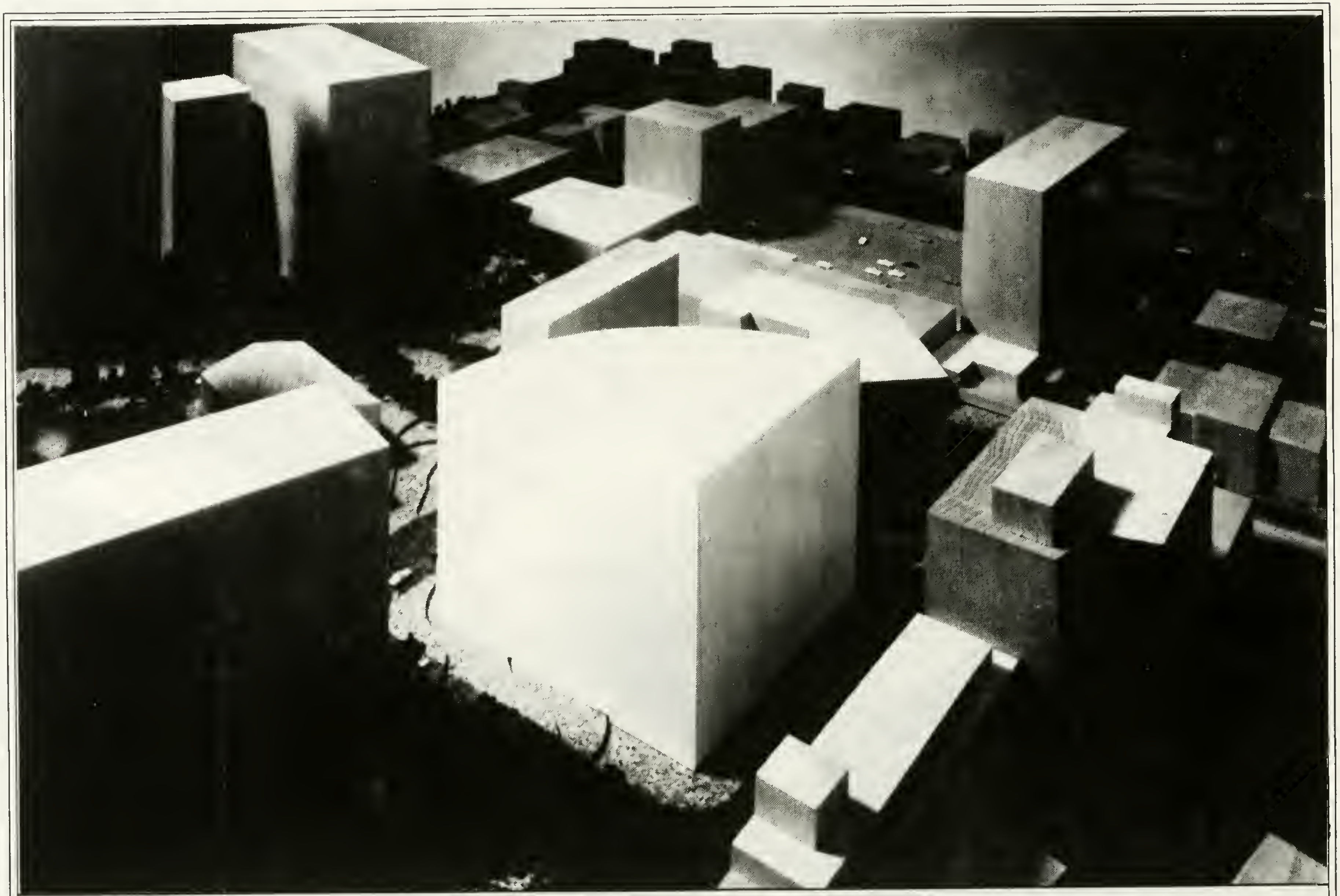


FIGURE VI-1.6
FILL IN OF LOWER FLOORS DURING PHASE II CONSTRUCTION

and to avoid blocking views and sunlight from St. Joseph's Church. The building height is 137 feet which is roughly 20 feet lower than the Two Hawthorne Place building, and in keeping with the height of the Wellman Building, located across Blossom Street. The height allows greater views from adjacent buildings.

The proposed project complies with the zoning setbacks and side and rear yard requirements, as outlined for the H-3 Zoning District. Parapet setback requirements are met for the west facade (Blossom Street). Parapet setback requirements for the north, south and east walls are not met, however, following the U-district rezoning, parapet setbacks are no longer required. In addition, the designed curved configuration of these walls adds views and sunlight more than the building wall massing built within the allowable zoning requirements. The floor area ratio exceeds the H-3 requirement of FAR 3.0 but is considerably less than the applicable IPOD FAR of 8.0.

The roof of the facility will have minimum projections for the patient elevator penthouse to protect views from Hawthorne Place and Longfellow Place. The trellis and rooftop garden and the two stair towers have been removed from the DEIR/DPIR scheme after negotiations with the abutters and BRA.

The DEIR/DPIR scheme had reduced the overall height of the building as well as the building footprint, thereby improving views from neighboring buildings. This was accomplished by decreasing the typical floor area, as well as the number of floors built above the truss in Phase I. See Figure VI-1.4 and VI-1.5. The lost square footage is built in Phase II, below the truss (Figure VI-1.6). This was made possible in the DEIR/DPIR proposal by repositioning the parking levels below-grade.

The area relocated to the position below the truss will not be available until completion of Phase II. Therefore, the research space which will be moved off-site during construction of Phase I will not return to the site until completion of Phase II (Figure VI-1.6). Also, other administrative functions will be relocated temporarily off-site prior to demolition of the existing building. The following is a list of the major modifications to the proposed project based on extensive community review and design review.

In the DEIR/DPIR scheme, the building height was reduced from 155 feet to 137 feet, creating a nine-story building. This height is compatible with the height of the Wellman Building across Blossom Street. Views (from Hawthorne and Longfellow) to the Southwest and the Charles River, are not affected. The south and east walls are curved to allow views (to the northeast) from the Blackstone to remain, and not be blocked, as in the PNF proposal. This curved wall also allows sunlight to the St. Joseph's Church property. The shape also results in lessened shadow impacts as compared to the PNF scheme.

The building footprint in the DEIR/DPIR was reduced from 30,000 to an average floor of 22,218 square feet. As a result of this reduction, as well as a height reduction, some administrative components of the hospital will be required to relocate until completion of the lower levels in Phase II.

The DEIR/DPIR reported that the reduced building footprint allowed the zoning setbacks to be met along Blossom Street and William Cardinal O'Connell Way. This results in a 26-foot ± dimension between the building face and curb. A recessed arcade on the first and second floor visually increases this dimension. Within this zone will be planting and trees, brick and concrete paving, and a wide, generous entrance stair to the building. This stair will provide an attractive outdoor seating area to be used in the same way as the steps in front of the existing Burns Institute. Sidewalk and building lighting will provide a well lit pedestrian pathway along William Cardinal O'Connell Way and Blossom Street. Lobby functions on the first floor Level One along these streets will ensure an active "storefront" appearance along the sidewalk.

In response to concerns about the apparent bulk of the PNF proposal, several things were done for the DEIR/DPIR. The ninth floor was set back, providing a terrace, but more importantly, the setback visually provides a break at the top of the building. Cooling towers were located within the building so as not to be obtrusive to the neighbors.

Several modifications were made in the DEIR/DPIR regarding vehicular circulation in response to neighborhood concerns. The parking garage entrance and exit has been relocated to Blossom Street. An earlier automobile drop-off on the north side has been deleted. It is now located within the building. This reduces potential traffic on William Cardinal O'Connell Way, and reduces the number of required curb cuts.

The parking levels are positioned below grade which allows the exterior walls to have occupied spaces with windows rather than the solid walls which would have been required to screen the cars.

Service to the building remains in approximately the same location as the original building, using the existing easement with the Archdiocese.

All mechanical equipment is located on the truss level (Level 5). Exhaust is directed onto Blossom Street, away from residential areas. This also removes potential noise sources from the roof of the building. Other exhaust is directed out the roof of the building.

2.0 BUILDING DESIGN

As described earlier, the building height and shape has been designed to respond to concerns of the neighboring property owners. The building walls re-establish a relationship with the adjacent streets, and the curved facade maintains views from and sunlight to from neighboring parcels on the west and south street trees repeat a pattern established by the Wellman Building and provide an enhancement for the park north of the site.

The design of the exterior is based on these factors as well as the restrictions inherent in building around and over the existing building.

The mass of the building is expressed as masonry block which is curved and shaped to respond to specific site factors. A curved segment of the block is carved away at the southeast to form the curved wall. On the north and west, an arcade at grade level is cut out to visually increase the distance to the street as well as provide a protected entrance area. At the parapet, the ninth floor is cut back to form a terrace and to visually lessen the height of the street wall. The corners at the stairs are also set back from the main facade to further reduce the bulk of the main facade.

The curved building wall is carved from the masonry block, an aluminum and glass window wall is designed to appear lighter and less heavy than the masonry facades. The street walls are masonry, in response to the neighboring buildings. A base is designed to tie these differing facades together, and extend around four sides serving as a screen for the parking and service entrances on the south and east.

The masonry walls are designed in a way to articulate the various openings. A rusticated granite base extends for two levels, followed by two-story openings containing levels 3 and 4. The fifth floor openings contain louvers, and are designed to fit within a grillework consistent with other openings. Levels 6 through 8 are a repetitive pattern of punched openings. The ninth level windows are stepped back and a trellis/sunscreen forms a parapet to complete the composition.

Materials on the perimeter will be of a pallette consistent with the neighborhood. A granite base at grade level will support a brick and pre-cast facade. Pre-cast sills, lintels and other trim pieces will be integrated into the masonry walls, and the lobby at the corner of the building will be largely a glass skin, allowing views into the facility. Other windows will be tinted and/or clear glass, with the exception of the curved wall. This wall will be a curtain wall made of aluminum members with a pattern of clear and/or tinted glass.

The site area at the south side of the facility is heavily landscaped. The sidewalk areas on William Cardinal O'Connell Way and Blossom Street have planting areas with trees and broad steps leading into the building. Lighting is included at grade level. Paving textures are a pattern of concrete and brick.

The design of the building was unanimously approved by the Boston Civic Design Commission after four public hearings and highly detailed review of the plans and design concept.

3.0 URBAN DESIGN CHARACTER OF SITE

The site of the Shriners Burns Institute is located in the Downtown IPOD (Subdistrict M) (Figure VI-3.1), an Urban Renewal Overlay distrct and in the H-3 Zoning District. Buildings in the area are predominantly high-rise residential to the north, medium and high rise uses to the west (Massachusetts General Hospital). South and east of the site are buildings of lower height, ranging from the 4-story St. Josephs' Rectory, to the 11-story Blackstone housing facility.

The as-of-right height for the IPOD is 125 feet, with an enhanced height of 155 feet. The proposed Shriners Burns Institute at 137 feet falls between these two numbers. However, the proposed height is not out of character with the buildings in the immediate area, as noted above. The building closely matches the height of the Wellman Research Building to the west. The Wellman Building currently obstructs views to the southwest from Hawthorne Place. The proposed Shriners Burns Institute at approximately the same height as the Wellman Building, does not further obstruct those views. The height at 137 feet, combined with the curved facade which eases views on the east and south, is designed to be compatible with its neighbors. The West End Land Assembly and Redevelopment Plan allows a 155 foot height limit at this site, Parcel 8.

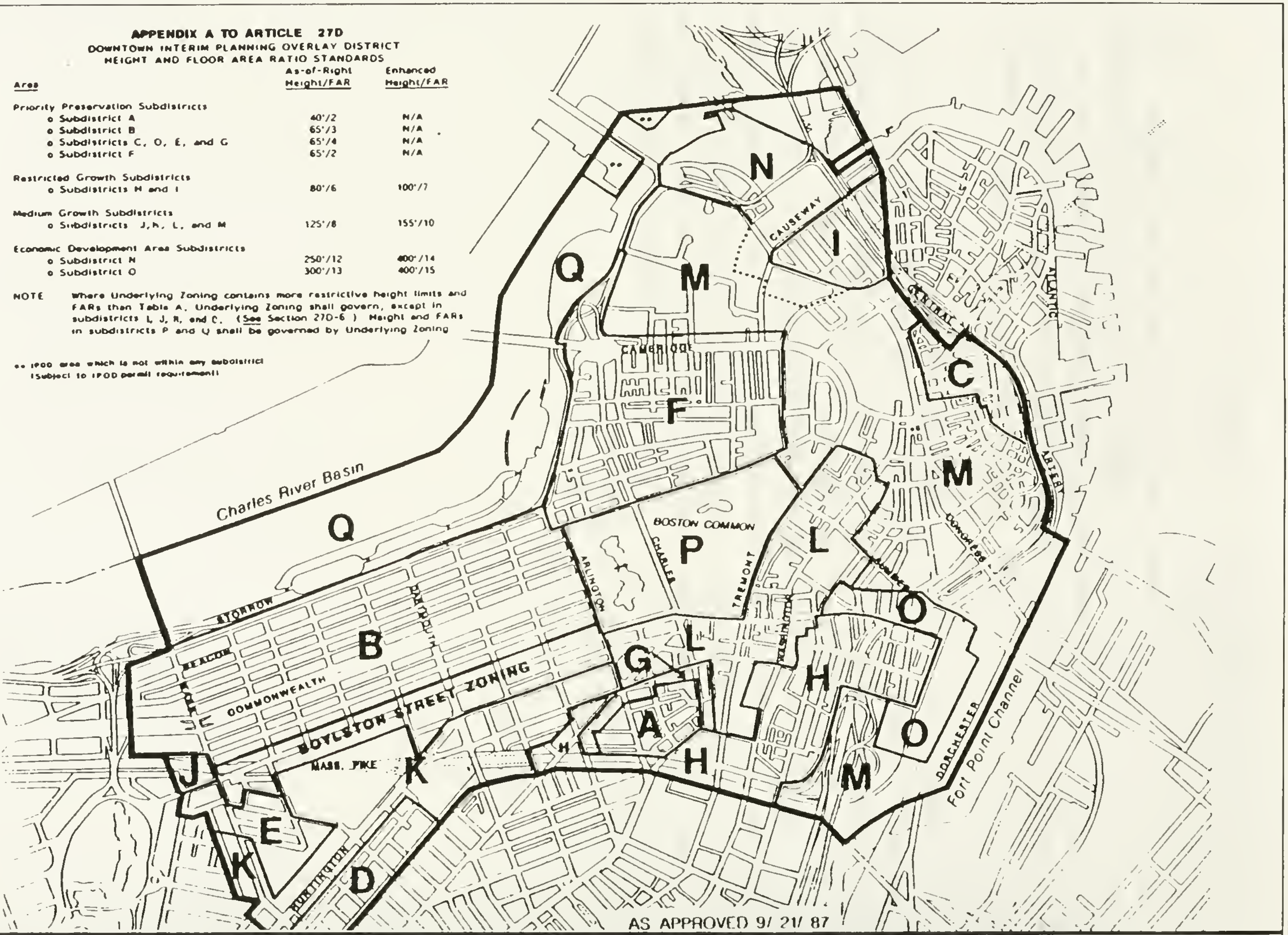
APPENDIX A TO ARTICLE 27D

DOWNTOWN INTERIM PLANNING OVERLAY DISTRICT
HEIGHT AND FLOOR AREA RATIO STANDARDS

Area	As-of-Right Height/FAR	Enhanced Height/FAR
Priority Preservation Subdistricts		
o Subdistrict A	40'/2	N/A
o Subdistrict B	65'/3	N/A
o Subdistricts C, O, E, and G	65'/4	N/A
o Subdistrict F	65'/2	N/A
Restricted Growth Subdistricts		
o Subdistricts H and I	80'/6	100'/7
Medium Growth Subdistricts		
o Subdistricts J, K, L, and M	125'/8	155'/10
Economic Development Area Subdistricts		
o Subdistrict N	250'/12	400'/14
o Subdistrict O	300'/13	400'/15

NOTE Where Underlying Zoning contains more restrictive height limits and FARs than Table A, Underlying Zoning shall govern, except in subdistricts L, J, K, and C. (*See* Section 27D-6) Height and FARs in subdistricts P and Q shall be governed by Underlying Zoning

•• IPOD area which is not within any subdistrict (Subject to IPOD permit requirement)



AS APPROVED 9/ 21/ 87

FIGURE VI-3.1
SUBDISTRICT IN DOWNTOWN IPOD
MEDIUM GROWTH DISTRICT

4.0 RELATIONSHIP TO EXISTING BUILDINGS

The form of the proposed Shriners Burns Institute is derived from its relationship with the neighboring buildings. As described earlier, the curve relieves views from the Blackstone and Regina Cleri, and provides sunlight to St. Josephs' Church, and views from the Church to the south and west.

The two street facades of the Shriners Burns Institute are pedestrian oriented. There are two entrances, each making a presence on its respective street. Wide sidewalks and planting buffers enhance these entrances. The William Cardinal O'Connell Way entrance is aligned with the vehicular entrance to Hawthorne Place. The Blossom Street entrance aligns with the Wellman Building entrance. Vehicular entrances for parking and service are located away from these pedestrian entrances.

Large glass areas in the lobby facades allow views of the park setting of Hawthorne to the north, and views through the glass lobby of Wellman to the Bulfinch Court.

The materials of the building, described earlier, are materials common to the area and result in a building which is compatible with its surroundings.

5.0 EXISTING PEDESTRIAN ENVIRONMENT

There are several pedestrian circulation paths in the area of the Shriners Burns Institute site (see Figure III-3.7). Both sides of Blossom Street carry pedestrians in each direction between Charles River Park to the north and shopping and the transit stop to the south on Cambridge Street.

Pedestrian traffic along William Cardinal O'Connell Way is also present. Pedestrians move from residential towers (to the northeast) to MGH use this pathway. Pedestrians also move each way between William Cardinal O'Connell Way through the garden between St. Josephs' Church and Regina Cleri, proceeding to destinations east and west of the Shriners Burns Institute.

The proposed streetscape of the Shriners Burns Institute will improve and enhance these areas of pedestrian movement. The current 8'-0" sidewalk will be replaced by a broader sidewalk, protected from the street by a landscaped buffer (see Figure III-3.6). Plant materials and trees in the buffer will provide an attractive green zone between pedestrians and vehicles. A recessed pedestrian arcade will further increase the width of the pedestrian areas. A rich pallette of materials, including granite, and brick, will make a pleasing visual experience for pedestrians. Lighting will add to the character of the street. The lighting at the sidewalk, combined with lighting from the lobby areas of the building (along Blossom Street and William Cardinal O'Connell Way) will improve visibility at night, resulting in a safer environment for pedestrians.

VII. Historic Resources Component

VII. HISTORIC RESOURCES COMPONENT

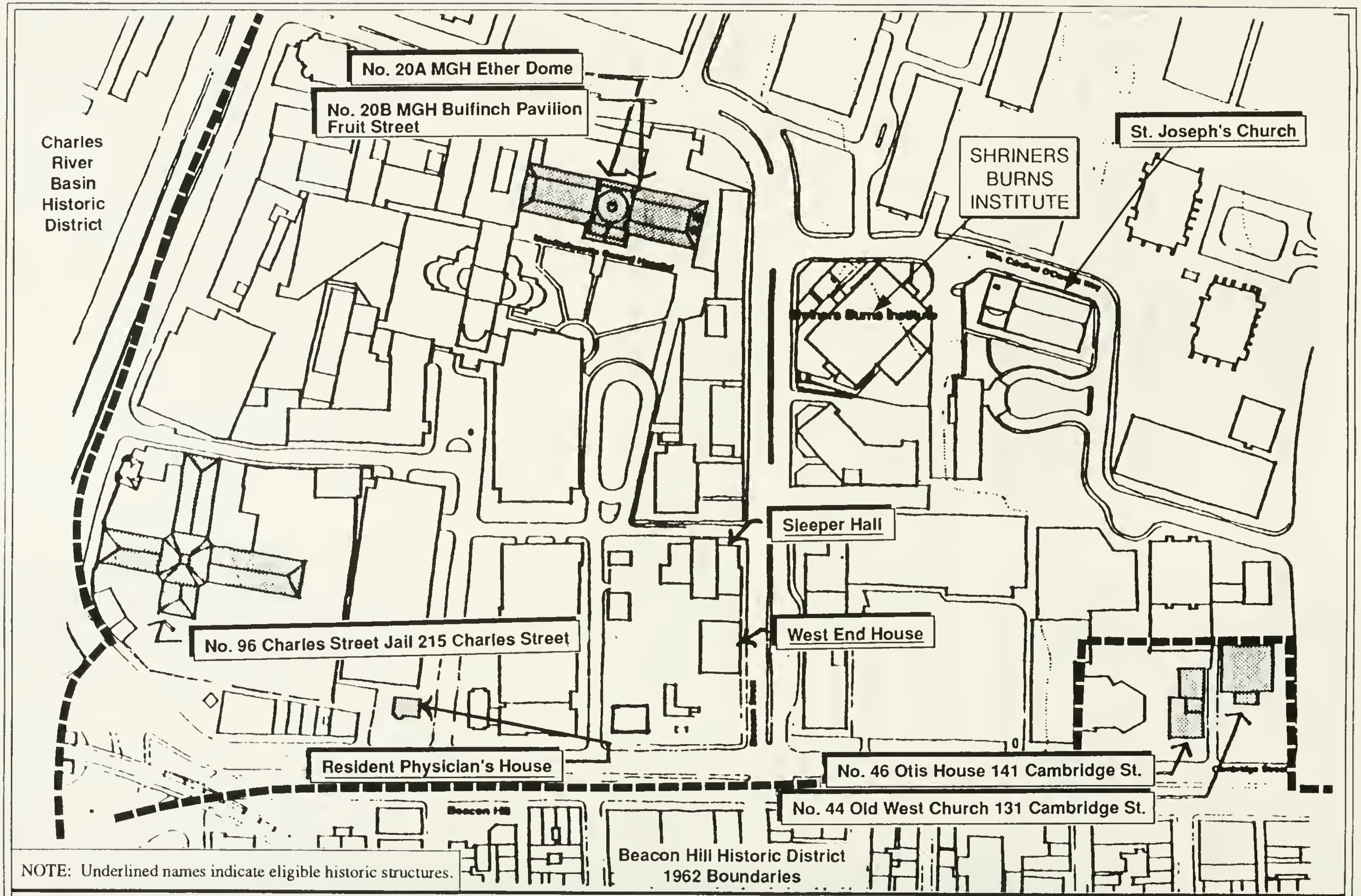
1.0 INTRODUCTION

There is no known historical or archaeological significance for the existing Shriners Burns Institute site at 51 Blossom Street. A review of the Massachusetts Historical Commission (MHC) files disclosed no archaeological sites within a one-half-mile radius of the site. A further review of MHC files also disclosed a number of historic structures in the vicinity and appearing on the National Register of Historic Places including:

- Otis House, 141 Cambridge Street
- Charles Street Jail, 215 Charles Street
- Old West Church, 131 Cambridge Street
- MGH Ether Dome, Fruit Street
- MGH Bulfinch Pavillion, Fruit Street

A full evaluation of potential project impacts on these historic structures and on nearby properties that may be eligible for State or National Register listing, is presented in Section 4.0.(see Figure VII-1.1 for identification of these structures.)

This component of the FPIR also presents summary information on the history of the project site.


No. 20A MGH Ether Dome
No. 20B MGH Bulfinch Pavilion Fruit Street
Charles River Basin Historic District
SHRINERS BURNS INSTITUTE
St. Joseph's Church
Sleeper Hall
West End House
No. 96 Charles Street Jail 215 Charles Street
Resident Physician's House
No. 46 Otis House 141 Cambridge St.
No. 44 Old West Church 131 Cambridge St.
Beacon Hill
Beacon Hill Historic District 1962 Boundaries

NOTE: Underlined names indicate eligible historic structures.

FIGURE VII-1.1
CULTURAL RESOURCES IN THE PROPOSED
PROJECT VICINITY

2.0 SITE HISTORY

The Preliminary Environmental Site Assessment for the existing Burns Institute* reviewed Boston City Hall and Boston Insurance Library records which included Sanborn Maps dated 1929, 1938, and 1989, and City of Boston Department of Public Works (DPW) plans. The records indicated that the land which is currently occupied by the Shriners Burns Institute is comprised of portions of several former residential properties as well as a portion of a property which was formerly occupied by a school.

The school was originally known as The Saint Joseph's School and was owned by the Roman Catholic Archbishop of Boston. The school was later known as the Wells School and was owned by the City of Boston. The homes and school were razed during the 1940's and the site remained vacant until the construction of the Shriners Burns Institute in 1968.

A City of Boston DPW plan of Blossom Street dated July 15, 1961 showed the taking of land in the area of the site in order to relocate Blossom Street. This plan also indicated the site was owned by the Boston Redevelopment Authority at this time. A second DPW plan dated December 19, 1966 illustrated the layout of William Cardinal O'Connell Way. The exact construction date of this street is unknown; however, DPW Officials indicated it is likely this street was constructed within a few years of this date.

The Saint Joseph's Church and rectory, which abuts the site to the east, was constructed in approximately the late 1800's. The property to the south of the site was formerly the William Blackstone School and was converted to a high-rise residential dwelling Blackstone Apartments within the last 10-15 years. Regina Cleri housing was constructed in the late 1970's and is located to the east of the Shriners site. The Massachusetts General Hospital complex is located approximately 200 feet west of the site and across Blossom Street. The main hospital has been in operation since the 1800's. Building additions and expansion of the hospital facilities has gone on progressively over the years. Today, the Massachusetts General Hospital complex occupies approximately 10 acres of land.

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* Preliminary Environmental Site Assessment for the Shriners Hospital for Crippled Children Located at 51 Blossom Street, Boston, Massachusetts, prepared by Hidell-Eyster, Technical Services, Inc., July 30, 1991, pages 3-4.

3.0 CULTURAL RESOURCES IN THE PROPOSED PROJECT VICINITY

Based on a review of Massachusetts Historical Commission records for the ENF there are five structures listed in the National Register of Historic Places located within a one-half mile radius of the site (see Figure VII-1.1). The structures appearing in the National Register of Historic Places are as follows:

- Otis House (National Register No. 46), 141 Cambridge Street
- Charles Street Jail (National Register No. 96), 215 Charles Street
- Old West Church (National Register No. 44), 131 Cambridge Street
- MGH Ether Dome (National Register No. 20A), Fruit Street
- MGH Bullfinch Pavillion (National Register No. 20B), Fruit Street
- Beacon Hill Historic District
- Charles River Basin Historic District

The Bulfinch Building is part of Massachusetts General Hospital and is located on Fruit Street. Construction of MGH's first building, once known as the Bulfinch Hospital, began in 1818. The hospital, designed by Charles Bulfinch, was built of White Chelmsford granite in the Classical Revival style. In 1844, town five-bay long extensions were added to the east and west ends of the original wings, doubling the size of the building. At that time, the interior of the building was also modernized and many more alterations have since taken place. Almost nothing of the original interior remains excepting town cantilevered stone stairways. The exterior of the front facade of the original center section, however, has been preserved virtually unaltered. The Ether Dome, also listed in the National Register, was completed in 1823 and occupies the top floor of this center section, known today as the Bulfinch Pavillion, The first demonstration of ether anesthetic in the U.S. took place under the Bulfinch dome, giving the dome its name. Portions of the Bulfinch Building are open to visitors, although it is used mainly for clinical research.

The Charles Street Jail (Suffolk County Jail) is located at the intersection of Charles Street and Cambridge Street, just south of Massachusetts General Hospital across Fruit Street. Designed by Gridley J.F. Bryant, the jail was built in the Boston granite style, convey a sense of boldness and strength. The structure's layout and design was considered an innovation of its time, build largely to alleviate the undesirable conditions of the

Leverett Street Jail. Some of the innovative features of the Charles Street Jail included communal exercise yards, large rooms and cells, infiltration of natural light through wall and cell windows, along with the added benefit of radiant heat from the sun and a complete ventilation system.

The First Harrison Gray Otis House is located at 141 Cambridge Street. In addition to being on the National Register of Historic Places, this structure has also been listed as a National Historic Landmark. The house was designed by Charles Bulfinch and built in 1796. It is the prototype of the series of Adamesque mansions built in New England during the Federal period. Structures built in this style are typically five-bays wide and three brick stories high. In 1926, the house was moved back 40 feet when Cambridge Street was widened, and at the same time underwent considerable alterations. In the 1960's, however, the house was restored to its original form and is now open to visitors as a furnished historic house exhibit.

The Old West Church is adjacent to the First Harrison Gray Otis House, across Lynde Street, at 131 Cambridge Street. The church, currently undergoing restoration, was designed and built by Asher Benjamin in the Federal-Adamesque style as a Congregational meetinghouse in 1806. The structure has been widely copied throughout New England. The interior underwent considerable alteration when it was converted to a public library in 1896. In 1963, the interior was restored to its original appearance and then opened as a United Methodist Church. It continues to be used as a Church today.

The Beacon Hill Historic District was registered as a National Historic Landmark in 1962. Several structures within the District have been registered as historic places in their own right. In 1963, the Beach Hill District was enlarged by the Massachusetts Legislature by about 70 acres, therefore, the Historic Landmark boundaries, which encompass approximately 50 acres, do not coincide with the state boundaries for the District.

The Beacon Hill District was developed between 1795 and 1808, with one of the leading architects being the noted Charles Bulfinch. Its three and four-story brick row houses are characteristic of the Adamesque-Federal style, and have remained virtually intact on the exterior. The District, still almost 90% residential, is one of the finest and least altered examples of a large Early Republican or Federal Period urban area in the United States.

In addition, there are a number of buildings that are included in the Inventory Historic and Archaeological Assets of the Commonwealth and that may be eligible for state or National Register listings including:

- The West End House, 16-18 Blossom Street
- Sleeper Hall, 24 Blossom Street
- St. Josephs Church, 68 William Cardinal O'Connell Way
- The Residents Physician's House, Cambridge and North Grove Streets

The project proponent has reviewed the City's files with the Environmental Department and the Massachusetts Historical Commission records with regard to the presence of archaeological sites within one-half mile radius of the site. None were found. In addition, as part of the Final Environmental Impact Statement/Report (FEIS/R) for the Artery/Tunnel project by the State Department of Public Works and FHWA, no archaeological sites were listed in the immediate vicinity.

4.0 ANALYSIS OF POTENTIAL EFFECTS

The proposed project is consistent with the height, scale and massing of existing buildings in the project area. The exterior materials will be of a pallette consistent with the adjacent neighborhood as well as the Cambridge Street and Beacon Hill areas. A granite base at grade level will support a brick and stone facade. Stone sills, lintels and other trim pieces will be integrated into the masonry walls, the lobby at the corner of the building will be largely a glass skin, allowing views into the facility. Other windows will be clear glass, with the exception of the curved wall. This wall will be a curtain wall made of aluminum members with a pattern of clear and tinted glass.

The site area at the south side of the facility will be heavily landscaped. This area will provide views of an attractive, landscaped park setting for the residents of Regina Cleri and the Blackstone.

As illustrated in Figures VII-4.1 through Figures VII-4.3, building styles in the project area are varied as well as heights which range from St. Josephs Church (50 feet) to Hawthorne Place (160-170 feet). Views from neighboring buildings will be improved by the curved design configuration of the wall facing the Blackstone Apartments and Regina Cleri. In addition, the proposed building walls re-establish a relationship with the adjacent streets (Blossom and William Cardinal O'Connell Way) by eliminating the current setbacks. This is also consistent with nearby structures (see Figure VIII-4.4).

The proposed Shriners Replacement Facility project will not be visible from any of the previously identified structures on the National Register of Historic Places because of views blocked by other intervening structures. The project will, however, be visible from three potentially eligible structures - St. Joseph's Church, Sleeper Hall, and the West End House.

Potential new project shadow impacts are limited to St. Josephs Church during the vernal equinox at 3:00 PM (see Figure V-1.3). At this time, the Church's rectory on the west face is in existing shadow which extends 12 feet vertically from the ground. The new shadow from the Shriners Replacement Facility will place the entire rectory's west face in shadow. The impact is not considered significant because the shadow on pedestrian areas is not increase at this time and the Church Rectory's west face does not contain windows. In addition, there should be no impact on existing vegetation adjacent to the Rectory's west face as existing shadows already extend to the ground level vegetation.

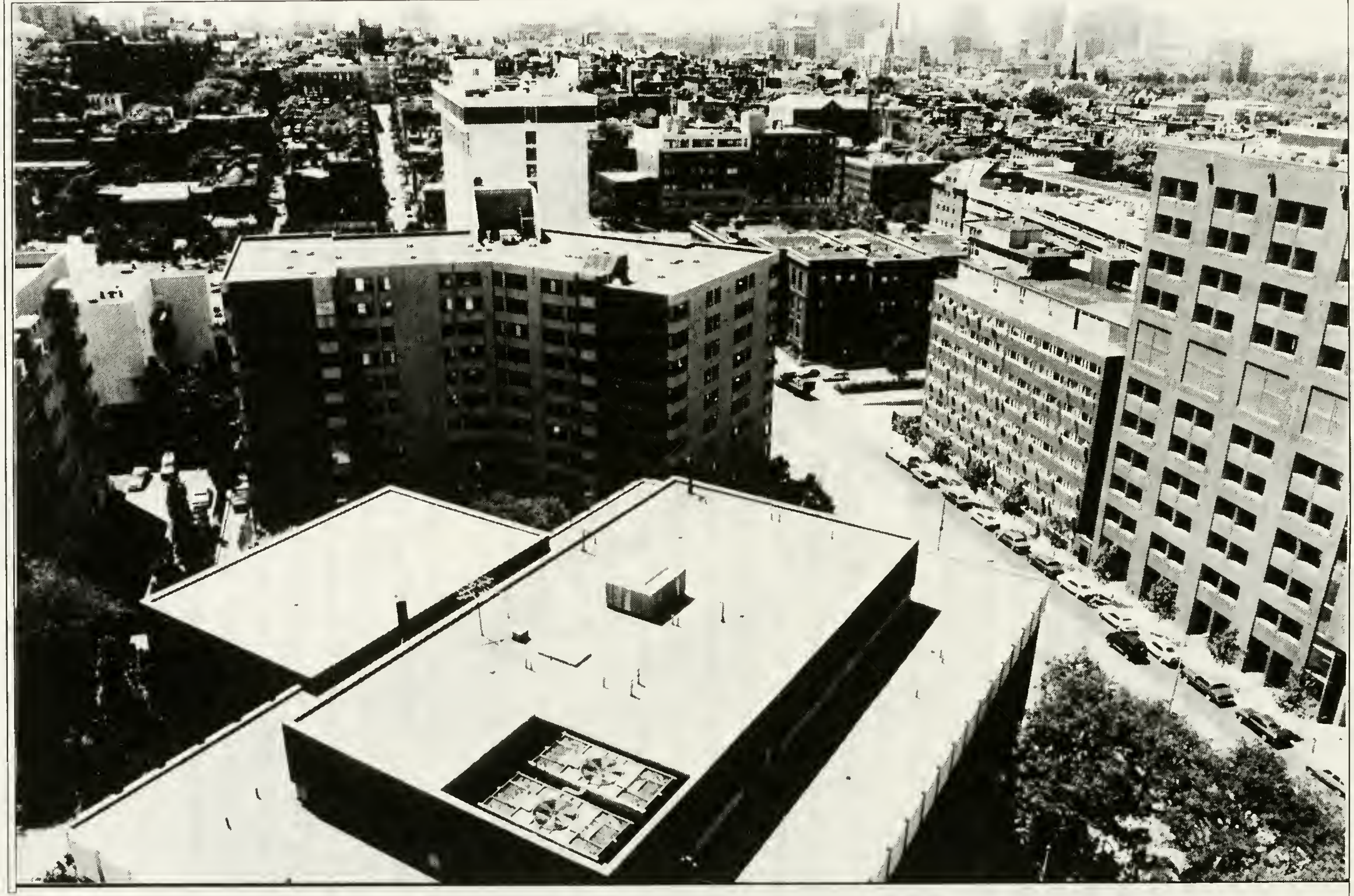

FIGURE VII-4.1
ROOFTOP VIEW OF SHRINERS BULDING TOWARD BLOSSOM STREET

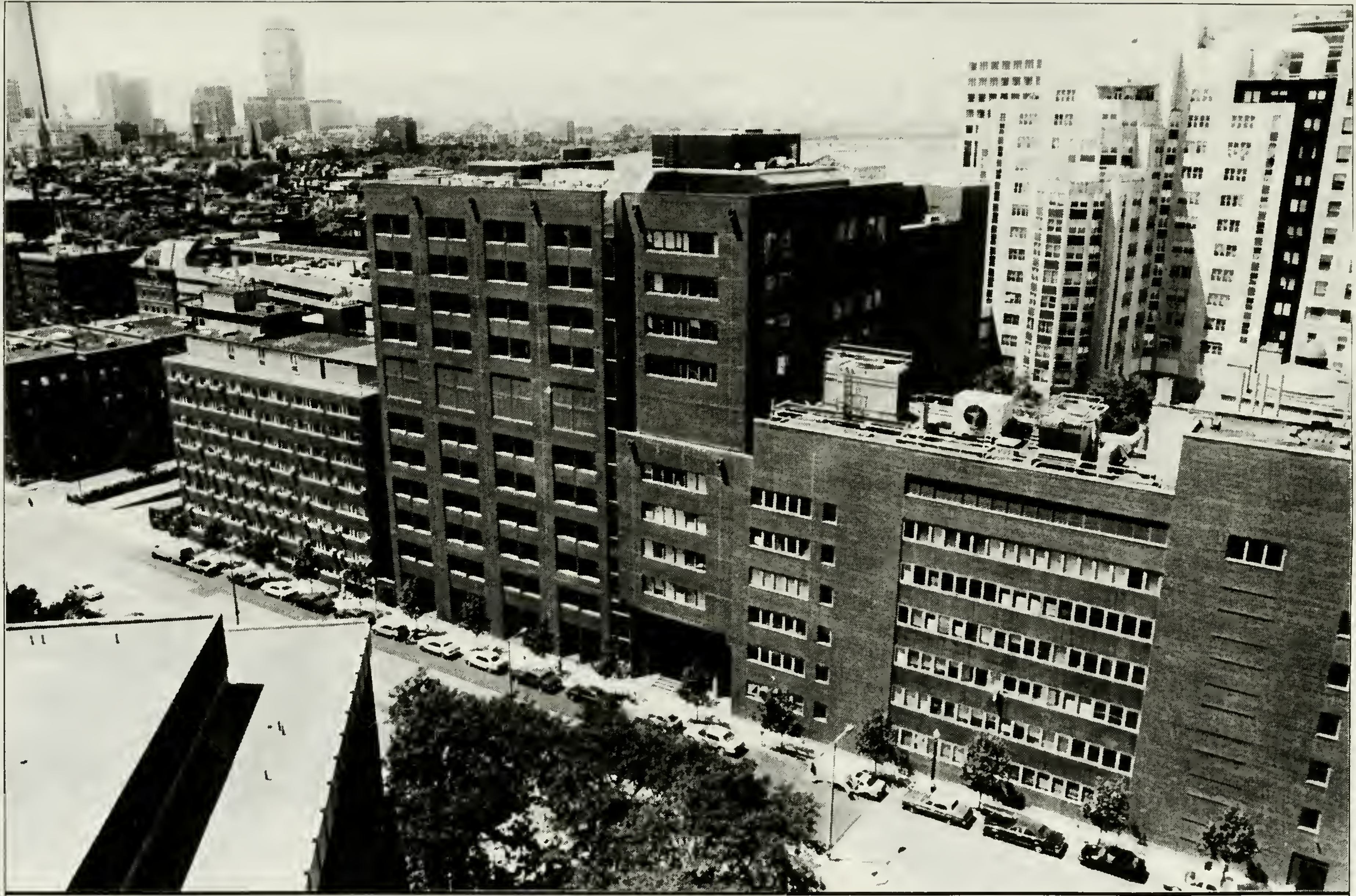

FIGURE VII-4.2
VIEW OF MGH's EDWARDS AND WELLMAN BUILDINGS
OPPOSITE THE SITE ALONG BLOSSOM STREET

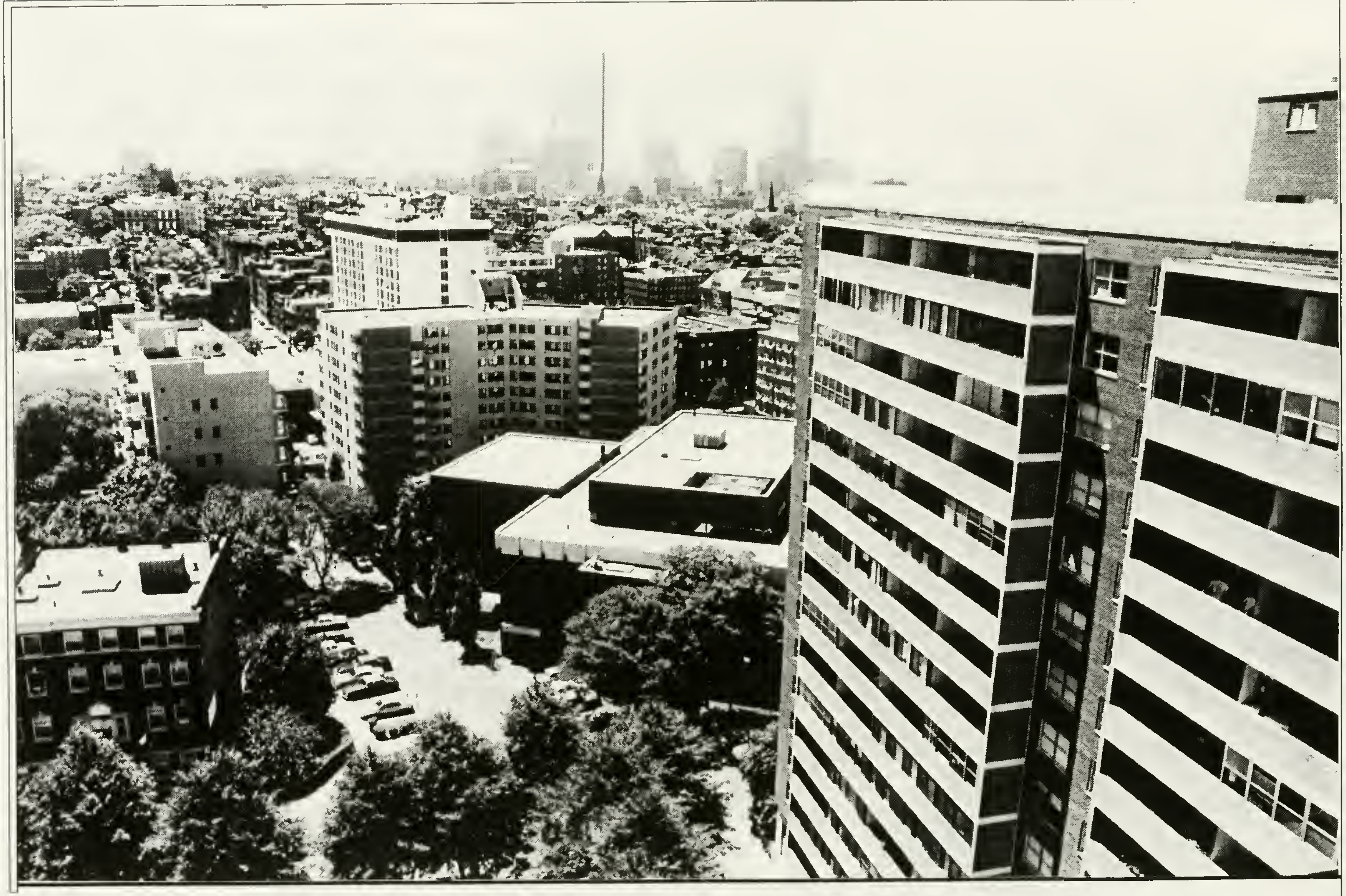

FIGURE VII-4.3
VIEW OF SHRINERS BURNS INSTITUTE FROM NINE HAWTHORNE PLACE

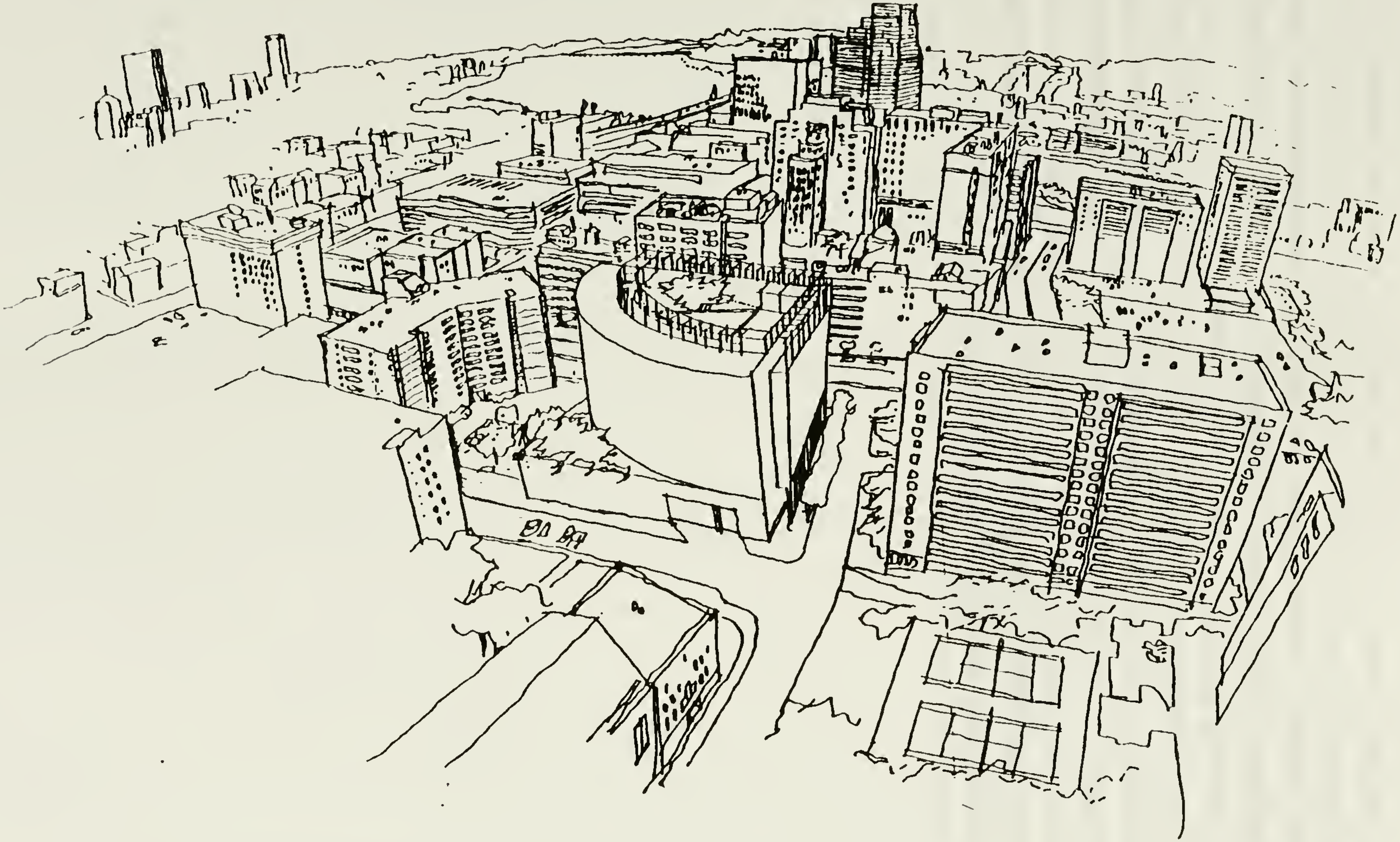

FIGURE VII-4.4
SCHEMATIC VIEW OF SHRINERS BURNS REPLACEMENT FACILITY

An off-setting impact at 3:00 PM on March 21 is that the adjacent courtyard and walkway between St. Joseph's Church and the Regina Cleri House experiences a reduction in shadow because of the new Shriners facility's massing configuration. This reduction which increases sunlight exposure at the ground level also enhances the skydome effect thereby increasing daylight.

There is no additional shadow impact on any of the other properties listed in Section 3.0 which includes both National or State Register or the other properties as noted which may be eligible. Please refer to Section V-2.0 for additional discussion of shadow impacts on structures within the project area.

The project will not adversely effect any archaeological sites as none were identified in MHC or City files within one-half mile of the project site.

5.0 MITIGATION

The Shriners Replacement Facility project is comparable with the height, scale and massing of other buildings within the vicinity of the project. Project design enhances views from Regina Cleri and the Blackstone Building. The overall height proposed has been revised (from 155 feet to 137 feet) to improve on impacts on the adjacent St. Josephs Church and Rectory. Existing shadows have been eliminated from the courtyard and walkway between St. Josephs Church and adjacent Regina Cleri House. Also, as indicated in the shadow studies discussed in Section V-2.0, the new facility's design has also led to elimination of some existing shadows to the rear of St. Josephs Church and on the walkway along William Cardinal O'Connell Way at various times during the year. Finally, there is no impact on vegetation as discussed in the previous Section (V-2.0) at St. Josephs.

VIII. Infrastructure Systems Component

VIII. INFRASTRUCTURE SYSTEMS COMPONENT

1.0 INTRODUCTION

The DEIR/DPIR identified and evaluated the impacts on local infrastructure systems and suggested mitigation measures. The impacts of the proposed project on the following systems were addressed:

- Water Distribution System
- Sanitary Sewer and Stormwater System
- Electric Service
- Steam Service
- Chilled Water
- Communications

Discussions of these systems and project related impacts are provided again in this FPIR. Additional information needed in response to comments received on the DEIR/DPIR is provided where necessary.

This section describes the existing systems, the impact of the project on the physical configuration of the systems, and the system's capacity to serve the proposed development. To determine expected utility use levels for each infrastructure element, estimates have been prepared for increased demands associated with the proposed project and have been discussed with the respective utility (e.g., Boston Edison, etc.). For each infrastructure element, the impact of the increased demands on the system is described and service connection information is provided. Proposed mitigation measures to reduce the impacts of the project are also presented.

The infrastructure impact analysis for the proposed project is primarily based on characteristic utility demand projections. All estimates for new levels of use assume full occupancy.

2.0 WATER DISTRIBUTION SYSTEM

2.1 Description of Existing Facilities

Existing water service for both domestic use and fire protection for the project site is supplied from water systems owned and operated by the BWSC. These systems are designated as the Low Service (LS) system, which is generally used to meet domestic water needs and some street hydrant demand and the High Service (HS) system which is generally used to meet fire fighting requirements. Both systems service the Shriners Burns Institute area.

This water supply system is integrally connected to form loops which allow major water demands to be fed from more than one direction. This looping allows each system to function at optimum efficiency, and to provide a measure of safety and redundancy in the event of a water main break. The BWSC water distribution system in the project area is shown in Figure VIII-2.1.

The existing LS and HS systems in the site vicinity have been tested for capacity via hydrant flow tests along Cambridge Street and the tested hydrants appear to be adequate to serve the development's water use needs and firefighting requirements (see Table VIII-2.1).

2.2 Project Water Use

The proposed Shriners Burns Institute water use will consist primarily of domestic water consumption. Average daily water consumption was estimated using the Title V guidelines and actual water use data obtained from an existing modern medical research facility. Peak use values have been estimated by applying a peaking factor of 3. Average daily domestic water is estimated to be 24,400 gpd with an instantaneous peak of 50 gallons per minute (gpm).

2.3 System Impacts

Based on recent hydrant flow test data, the existing LS water system serving the project has a capacity of approximately 2,400 gpm at 59 psi, which is more than adequate to supply the 50 gpm peak demand of the Shriners Burns Institute. The project also

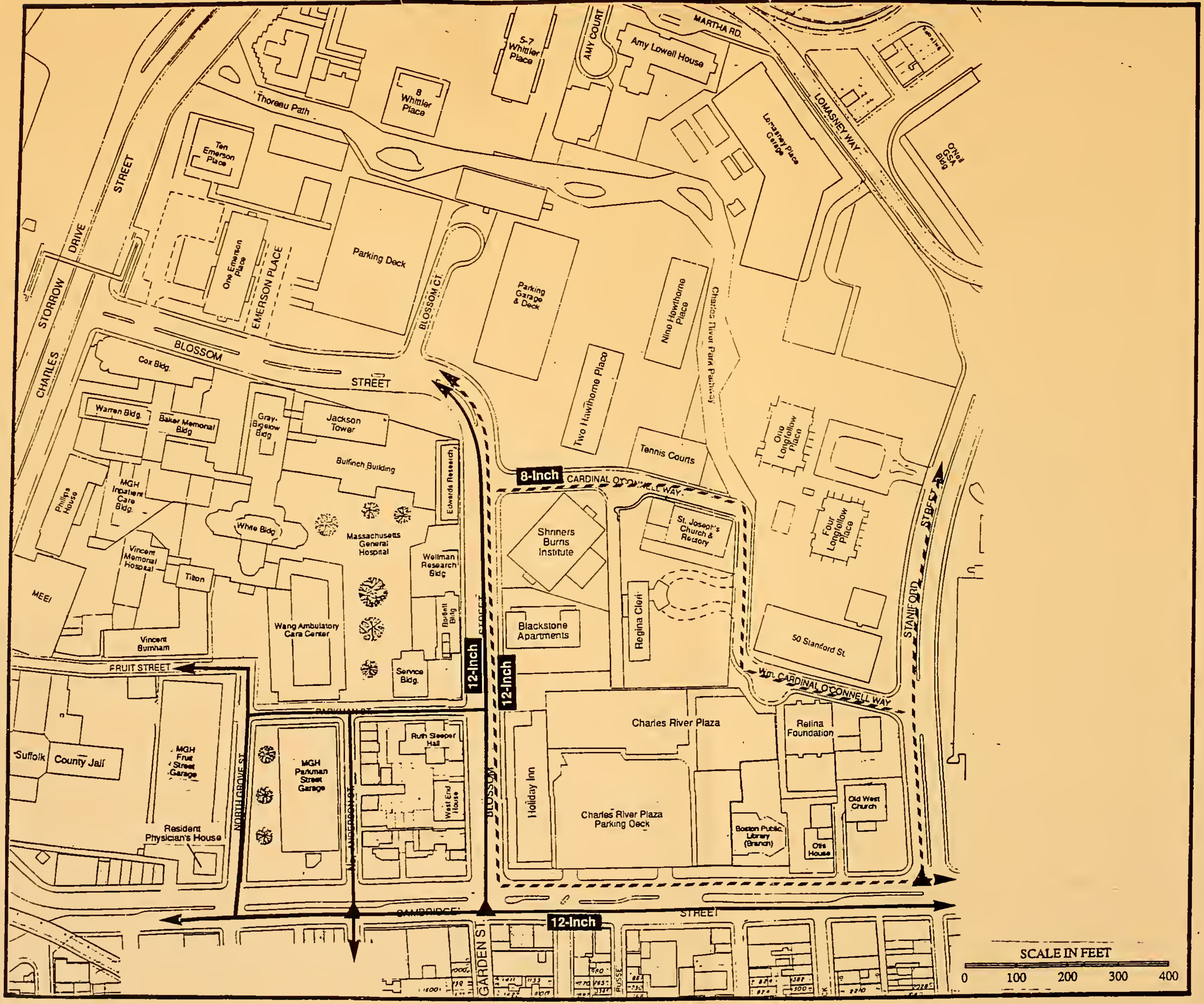

FIGURE VIII-2.1
WATER DISTRIBUTION IN THE PROJECT VICINITY

LEGEND

▬	Southern Low Pressure Service
- - -	Southern High Pressure Service
▲	Hydrant Test Locations

TABLE VIII-2.1
HYDRANT FLOW TESTS
SHRINERS BURNS INSTITUTE

Hydrant Test Location	Test Date	Static Pressure	Measured Flow at Residual Pressure	Calculated Flow at 20 psi Residual Pressure(1)
12" LS Cambridge & Anderson	3/87	67 psi	2,400 gpm @ 59 psi	NA(2)
12" HS Cambridge & Stanford	3/87	81 psi	18,400 gpm @ 74 psi	5,910 gpm
12" HS Cambridge & Garden	12/90	95 psi	2,474 @ 92 psi	14,071 gpm

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Notes:

(1) In general, to meet firefighting requirements, 2,000 gpm at 20 psi or residual pressure is considered adequate.

(2) Determination of flow at 20 psi for firefighting purposes was not made at the Low Pressure Service Hydrant at Cambridge and Anderson due to the proximity of the High Pressure Service Lines.

requires a fire flow of approximately 2,000 gpm. The existing HS water system is capable of supplying approximately 5,910 to 14,071 gpm at 20 psi which is more than adequate to meet the firefighting requirements of the project.

2.4 System Connections

Domestic Water and Fire Protection Service will likely be obtained from the existing connection to the 12-inch LS municipal water main under Blossom Street. Fire Protection Service will be provided from the 12-inch HS municipal water main also located under Blossom Street.

2.5 Water System/Mitigation Measures

In order to minimize water use, the Shriners Burns Institute will meet all applicable code requirements for the installation of low flow fixtures. In addition, the Institute plans to use the water resources as effectively as possible and are evaluating various operational approaches to achieve this goal. Additional measures to conserve water will include the use of plantings and fountains that require low water use.

The new Replacement Facility will replace an existing facility which does not make use of low flow fixtures and other water use minimizing measures. In addition, the present one-way heating system, with the corresponding need for cooling water, will be replaced by a new steam/hot water system, with steam provided by Boston Thermal. Steam condensate will be returned and not discharged to the sewer system.

3.0 SANITARY SEWER AND STORMWATER SYSTEM

3.1 Description of Existing Facilities

The project is served by a sanitary sewer system owned and operated by the BWSC. The routing of sanitary wastewater from the project site to a main interceptor sewer is shown in Figure VIII-3.1 and is described below.

The results of an evaluation of the capacity of the existing sewer routing are shown in Table VIII-3.1.

The capacity of each sewer segment has been calculated based on the Manning equation and sewer sizes, manhole invert elevations and segment length data taken from BWSC wastewater system maps. HMM Associates has been in contact with the Massachusetts Water Resources Authority (MWRA) and BWSC with regard to this project and the following connection option has been discussed. BWSC personnel have stated that there are no known problems with the affected sanitary sewer lines, and as a result, there are no plans to replace the sewer lines in the near future (HMM telephone conversation with Paul Keohane of BWSC 2/7/92).

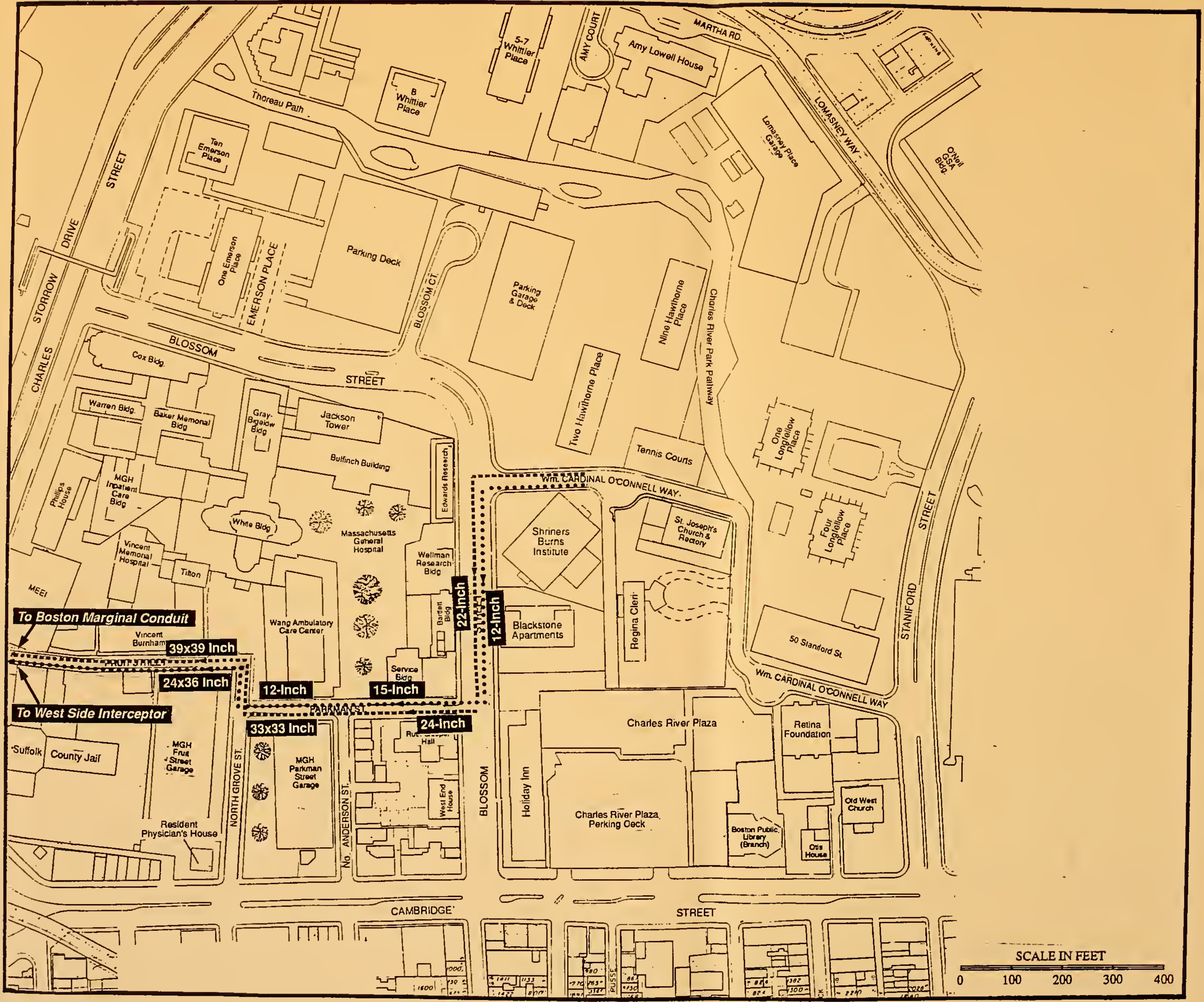
3.2 Project Wastewater Generation

The majority of wastewater generated by the new development is domestic sewage. The sewage generation rates have been estimated by use category based on Title V guidelines and on actual water use data available from an existing modern medical research facility, which resulted in a water use factor of 0.203 gallons per square foot per day. The total additional average domestic sewage discharge generated by the facility is projected to be 24,400 gallons per day (gpd).

3.3 Sanitary Sewer Connections

New sanitary sewage service connections will be made during the construction of the new facility. Two sanitary and two storm drain connections will be made to the proposed building. The sanitary connections will be located near the building corner on Blossom Street and near the building corner on William Cardinal O'Connell Way. The storm drain connections will be located adjacent to the sanitary connections. Preliminary discussions with the BWSC have indicated that this location will be acceptable. This sewer runs under

FIGURE VIII-3.1
SANITARY SEWER AND STORM DRAIN ROUTING



LEGEND

- •••••••••• Sanitary Sewer
- ▪▪▪▪▪▪▪▪▪▪ Storm Drain

hm
m

TABLE VIII-3.1
SHRINERS BURNS INSTITUTE
SEWER CAPACITY EVALUATION*

Segment MH - MH	Street Name	Segment Size (inches)	Segment Length (ft)	Slope (ft/ft)	Capacity (MGD)
85-77	Blossom Street	12	405	0.0160	2.53
77-75	Blossom Street	15	110	0.0081	3.26
75-63	Parkman Street	15	220	0.0043	2.38
63-59	Parkman Street/ Fruit Street	12	300	0.0062	1.58
59-24	Fruit Street	24 x 36	60	0.0150	38.94
24-20	Fruit Street	24 x 36	260	0.0002	4.41
20-RE MC-9	Fruit Street	24 x 36	235	0.0001	3.59
	TOTAL LENGTH		1,590		

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* Manhole identification numbers, sewer sizes, invert elevations and segment lengths from BWSC wastewater system maps No. 25J and 25K. Capacity calculated using Mannings' Equation with a coefficient of roughness of 0.015 (fair condition brick or concrete).

Blossom Street to the intersection of Blossom Street and Parkman Street. The sewer then turns under Parkman Street as a 15-inch sewer which runs to the intersection of Parkman Street and North Grove Street where it turns under North Grove Street and runs to Fruit Street. The sewer discharges into a 24-inch x 36-inch sewer which runs under Fruit Street to intersect with the West Side Interceptor.

3.4 Mitigation

For new construction projects requiring connection to the sewers, an application for a sewer connection permit will be required in accordance with 324 CMR 7.00. The sewer connection application together with a water and sewer site plan will be submitted to the BWSC. The BWSC will approve and forward the application to the Department of Environmental Protection (DEP) - Division of Water Pollution Control (DWPC). The permit application must be submitted at least ninety days prior to construction of this work. In addition, a sewage connection permit must be filed with the MWRA due to the presence of non-sanitary wastewaters.

BWSC personnel have stated that there are no known problems with the affected sanitary sewer lines. In order to mitigate the impacts of the new sewage generation, the use of low flow fixtures mentioned above can reduce the projected water consumption and the estimated sewage generation rates by up to 20 percent. However, because water use estimates were generated using actual data from a modern facility whichmakes use of low flow fixtures and other water saving measures, water use projections should be representative of actual final design project use.

In order to mitigate the impacts of the new sewage generation, the Shriners Burns Institute will meet all applicable code requirements for the installation of low flow fixtures. The use of low flow fixtures can reduce the projected water consumption and the estimated sewage generation rates by up to 20 percent. However, because water use estimates were generated using actual data from a modern facility which makes use of low flow fixtures and other water saving measures, water use projections should be representative of actual final design project use.

The new facility will replace an existing building which does not utilize low flow fixtures and other water use minimizing measures. As a result the incremental additional sanitary wastewater generated by the new facility will be off-set by the elimination of wastewater generated by the existing facility.

Project loading to the BWSC sewer system compared with present discharge will be further reduced by eliminating steam condensate discharge into the sanitary sewer. This represents a minimum reduction of approximately 3,900 gallons per day.

The design and construction of all proposed service connections and system modifications will be performed to the standards of the BWSC and will be subject to their review and approval. Existing sewer connections and service to the area will be maintained during construction of the new facilities. If interruptions are necessary due to construction activities, they will be coordinated with the BWSC so as to minimize impacts in the service area.

3.5 Project Storm Drainage

The site is largely built up or paved with existing buildings or parking areas. There will be only a minor increase in impervious areas. The proposed project will not result in substantial changes to stormwater runoff volumes, although discharge points to the adjacent collection system may be altered. Based on discussions with the BWSC, there are no known stormwater problems within the project area. The proposed routing will be through an existing storm drain in the southwest corner of the present facility which is connected to the existing 22-inch main located under Blossom Street. Storm drain routing for the facility was presented previously in Figure VIII-3.1. Approved API oil/water/sand separators will be included in the underground parking garage.

Stormwater runoff from the facility will follow a route that parallels that of the sanitary sewer. Discharge from this sewer will empty into the Boston marginal conduit.

4.0 ENERGY SYSTEMS

4.1 Energy Use Strategies

It is anticipated that steam and electricity will be the main source of space heating, air conditioning, lighting, mechanical equipment and hot water for the Shriners Burns Institute. Natural gas will not be used to supply any facility needs.

4.2 Electric Service

Existing electric service to the project area will be maintained at all times during construction. New service to the proposed facility will be provided by the construction of electric vaults to transform power to meet the new load requirements. Details of proposed modifications and implementation schedules will be coordinated throughout design and construction with Boston Edison. The estimated load for electricity is 4,159 KVA. Boston Edison has confirmed that the additional load will not cause a noticeable impact on existing electrical capacity in the area. (HMM telephone conversation with Boston Edison, 2/7/92.)

Efforts to conserve energy will lead to reduced site needs. Compliance with the new State Building Code requirements for such items as lighting and insulation, are expected to minimize electrical energy consumption.

4.3 Steam Service

The project's steam supplier has not been finalized yet. As a result, service connections are not known at this time. Steam will provide building heating, humidification, hot water generation and instrument sterilization. Estimated steam requirements are shown below: There will be no discharge of steam condensate. All steam condensate will be returned to BTE.

	Peak	Average Annual	
	(lb/hr)	(lb/hr)	(Btu/yr)
Heating	9000	1370	1.2×10^{10}
Hot Water	7850	56	4.9×10^{8}
Sterilization	1100	82	7.2×10^{8}
Humidification		108	9.5×10^{8}

4.4 Chilled Water

The estimated load for chilled water is approximately 900 tons of refrigeration. Refrigeration will be generated in house by means of centrifugal water chillers and cooling towers for heat rejection. Peak design makeup is estimated to be 25 gpm to replace water losses due to evaporation and drift.

5.0 COMMUNICATIONS

The existing NYNEX conduits enter the Institute via four 4-inch fiber cables. It is believed that there is sufficient capacity in these conduits to handle the growth caused by the construction of the Shriners Burns Institute.

IX. Response to Comments on the DPIR

IX. RESPONSE TO COMMENTS ON THE DPIR

The following comment letters were received on the DPIR:

1.0 Boston Redevelopment Authority, Preliminary Adequacy Determination, April 23, 1992

2.0 Boston Environmental Department, November 22, 1991

3.0 Massachusetts Historical Commission, December 4, 1991

4.0 Boston Water & Sewer Commission, December 5, 1991

5.0 Rappaport & Rakov, December 5, 1991

6.0 Nancy Buehler, December 5, 1991

7.0 Widett, Slater & Goldman (on behalf of Hawthorne Place Condominium Trust), December 5, 1991

8.0 Bruce Campbell & Associates, December 4, 1991

9.0 Widett, Slater & Goldman (on behalf of Blackstone Company), December 6, 1991

10.0 St. Joseph's Church, December 5, 1991

1.0 BRA / DPIR PRELIMINARY ADEQUACY DETERMINATION
APRIL 23, 1992

The Boston Redevelopment Authority has continued to meet with the proponent on project related issues and impacts. A number of neighborhood meetings have occurred since the filing of the DEIR/DPIR. These have included seven meetings with neighborhood or Hawthorne Place Condominium Trustee representatives. Updated schematic design information and landscaping plans have been presented at these meetings as well as a fuller elaboration of traffic and parking, shadow and wind impacts. At four of these meetings held by the BRA or members of the Zoning Commission, neighborhood representatives have invited appropriate experts on traffic and parking, and urban design and architecture to respond to specific concerns in these subject areas. It is expected that these neighborhood meetings will continue through the BRA's Design Review process.

The BRA's Preliminary Adequacy Determination, with respect to the Draft Project Impact Report, was issued on April 23, 1992. The BRA determined that "but for the required corrections, clarifications, and additional information referenced in the attached Technical Appendix, the DPIR submitted is sufficient to satisfy the scoping requirements." Detailed responses to the Technical Appendix issues raised in the April 23, 1992 letter are provided below.

1.1 Transportation Component

A draft Transportation Access Plan ("TAP") Agreement for execution between the City of Boston and the project proponent is being developed by the Boston Transportation Department. The TAP will be reviewed by the City and Shriners, and a final TAP executed in the fall of 1992.

1.2 Environmental Component

o Solid and Hazardous Waste

The BRA noted more detailed information should be provided on the proposed recycling/waste reduction program, including commitments to the program.

Response: This issue is addressed in Section V-7.5 on solid and hazardous waste mitigation measures.

o Operational Noise

The BRA noted a map should be included in the FEIR indicating the receptor locations.

Response: This map is included in Figure IX-1.1

1.3 Urban Design Component

The BRA noted that the FPIR must include information on the design changes voted upon by the BRA Board at its April 9, 1992 meeting.

Response: The minutes of the April 9, 1992 BRA Board meeting indicate that the BRA voted to amend the Shriners submitted Development Plan by adding the following:

- That the trellis and garden be removed from the roof to reduce overall height of the project. (By this deletion, total height is reduced by 11 feet, from 148 feet to 137 feet.)

- That the Shriners will work with the BRA design staff to improve wind conditions in the area through landscaping canopies, or other architectural elements. (In response, Shriners met with the abutters on May 6, May 7, June 25, and July 23, 1992 to review design modifications. Improvements resulting from these discussions included additional setback of the glass corner by five feet from the William Cardinal O'Connell Way and Blossom Street intersection, the addition of canopies at the two entrances, and an additional cornice at the third floor as mitigation measures.)

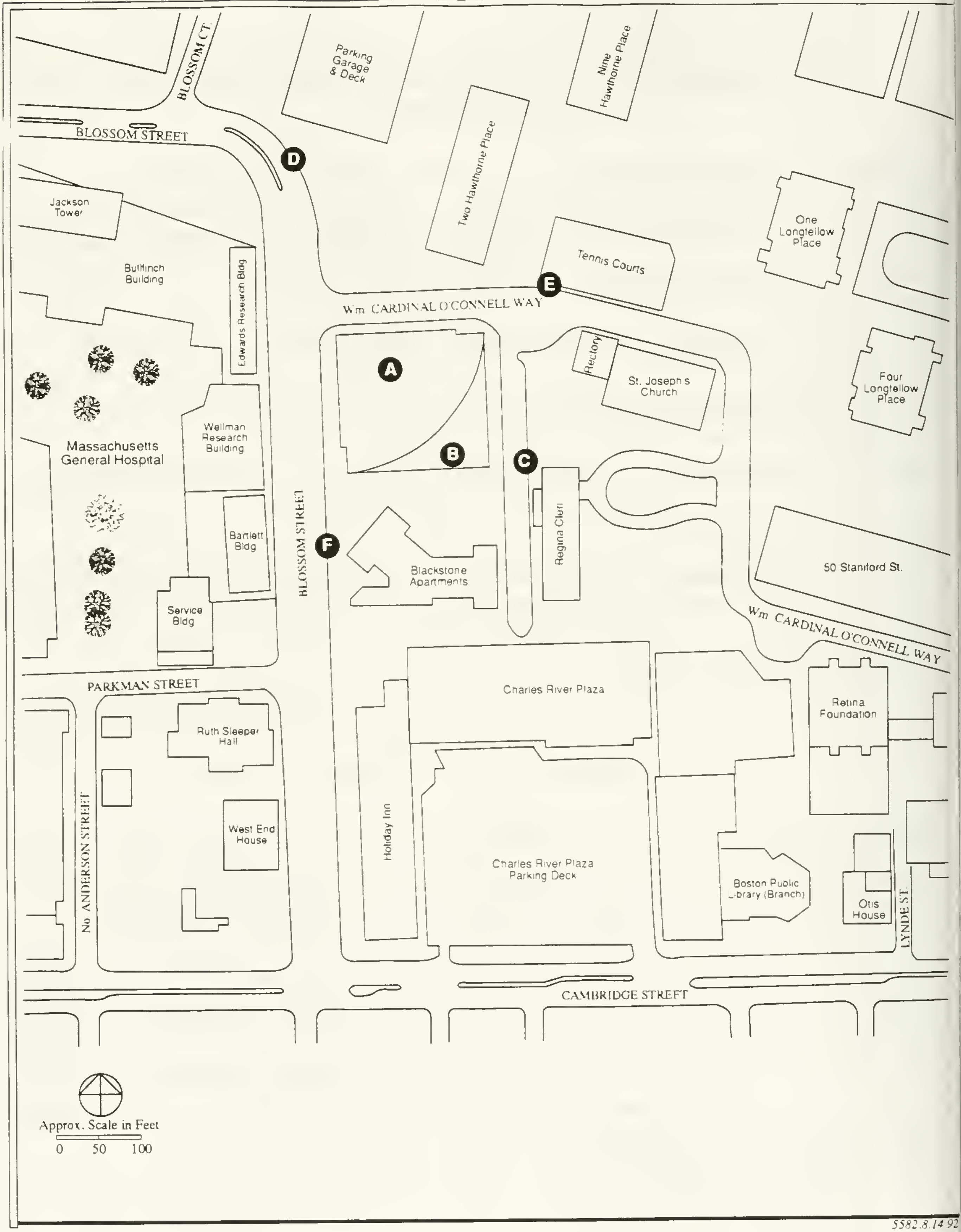

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FIGURE IX-1.1
NOISE RECEPTOR LOCATIONS

- That the BRA staff work with Shriners to develop a landscaping plan for public property along Cardinal O'Connell Way and Blossom Street to improve attractiveness and quality of the area. (At the June 25 and July 23, 1992 meetings with the abutters, four landscaping options were presented by the Shriners for further consideration.)

- That the BRA design staff work with Shriners and interested community groups to address design review issues through the completion of the design review process. (As stated above, four meetings have taken place under the auspices of the BRA or Zoning Commission to continue design review discussions as required in the April 9, 1992 BRA Board vote.)

1.4 Infrastructure Systems Component

The DEIR/DPIR analysis was felt by the BRA to be adequate but required additional information including:

o Information on the differences between existing and proposed build-out conditions.

Response: The new facility will replace an existing building which does not utilize low flow fixtures and other water use minimizing measures. As a result, the incremental additional sanitary wastewater generated by the new facility will be offset by the elimination of wastewater generated by the existing facility. Project loading to the BWSC Sewer System compared with present discharge will be further reduced by eliminating steam condensate discharge into the sanitary sewer. This represents a minimum reduction of approximately 3,900 gallons per day.

- Location of hydrants (for tests).

  Response: Fire Hydrant Test Locations are identified on Table VIII-2.1 of the FPIR.

- Description of BTE steam system service connections.

  Response: The Shriners Burns Institute project steam supplier has not yet been determined. Service connections are unknown at this time.

- Quantification of any water loss associated with the cooling tower blowdown.

  Response: The peak design makeup for the cooling tower due to blowdown and evaporation and drift losses is 25 gpm.

- Evidence of correspondence with Boston Edison concerning the design of electrical vaults.

  Response: Boston Edison has confirmed that the estimated additional load (4159 KVA) from the Shriners Burns Institute will not cause a noticeable impact on existing electrical capacity in the area (HMM telephone conversation with Boston Edison, 2/7/92). New electrical vaults are being designed with Boston Edison's specifications to minimize any impacts on open space or pedestrian ways.

- Conferring with BWSC regarding both the service life of adjacent utility lines and the potential need for upgrading the 12-inch limiting segment of the sanitary sewer line in Parkman/Fruit Street.

  Response: BWSC personnel have stated that there are no known problems with the adjacent utility lines (HMM telephone conversation with BWSC, 2/7/92). There are no plans to replace the 12-inch sanitary sewer line in Parkman/Fruit Street in the near future.

BOSTON
REDEVELOPMENT
AUTHORITY

Raymond L. Flynn
Mayor

Stephen Coyle
Director

One City Hall Square
Boston, MA 02201
(617) 722-4300

1.0

April 23, 1992

Mr. Burton E. Ravellette, Jr.
Owner Representative
Shriners Hospital for Crippled Children
Boston Burns Institute
51 Blossom Street
Boston, MA 02114

Re: **Shriners Burns Institute**
Replacement Facility Project

This letter is the Preliminary Adequacy Determination (the "Determination") of the Boston Redevelopment Authority (the "BRA") with respect to the Draft Project Impact Report (the "DPIR") for the proposed Shriners Burns Institute Replacement Facility Project (the "Proposed Project").

The BRA is issuing this Determination pursuant to Section 31-5 of the Boston Zoning Code (the "Code"). This Determination requests additional information required by the BRA for its review pursuant to Article 31 of the Code.

The BRA is reviewing the Project pursuant to multiple sections of the Code. The Proposed Project is being reviewed pursuant to Article 31 of the Code, Development Review Requirements, which sets out a comprehensive procedure for project review, and requires the issuance of a Final Adequacy Determination prior to issuance of a building permit. The Final Adequacy Determination is issued upon determination by the BRA that the Final Project Impact Report (the "FPIR") is satisfactory.

But for the required corrections, clarifications, and additional information referenced in the attached Technical Appendix, the DPIR submitted is sufficient to satisfy the scoping requirements.

We look forward to reviewing the Final Project Impact Report.

Sincerely,

Gerard Kavanaugh
Assistant Director for Institutional Planning
and Development

TECHNICAL APPENDIX
TO THE
PRELIMINARY ADEQUACY DETERMINATION
FOR
SHRINERS BURNS INSTITUTE
REPLACEMENT FACILITY PROJECT

A. DEVELOPMENT REVIEW REQUIREMENTS - ARTICLE 31

Article 31 of the Code institutes a process by which large-scale development projects will be reviewed by the BRA. In its review of the DPIR, the BRA has identified certain components which are insufficient and which the Proponent must modify, and additional information which the BRA requires in order to issue a Final Adequacy Determination. The following is a description of the sufficiency of the materials submitted in the DPIR, and the additional materials which the Proponent must include in the FPIR.

1. GENERAL INFORMATION

The general information provided in the DPIR is sufficent to satisfy the scoping requirements.

2. TRANSPORTATION COMPONENT

The Boston Transportation Department ("BTD") is currently drafting a Transportation Access Plan ("TAP") Agreement for execution between the City of Boston and the Proponent. A TAP Agreement must be finalized prior to the formal issuance of an Adequacy Determination by the BRA.

3. ENVIRONMENTAL COMPONENT

The analyses of wind, shadow, daylight, solar glare, air quality, geotechnical, water quality, construction and rodent control impacts presented in the DPIR are sufficient to satisfy the scoping requirements. More detailed information must be provided in the FPIR on the proposed recycling/waste reduction program, including commitments to the program. In addition, the FPIR must include a map indicating sensitive receptor locations and heights.

4. URBAN DESIGN COMPONENT

The information presented in the DPIR, together with the submission of required schematic documents, indicate an acceptable schematic design for the Project. The FPIR must include include information noting the design changes voted upon by the BRA Board at its April 9, 1992 meeting.

5. HISTORIC RESOURCES COMPONENT

The information provided in the DPIR concerning historic resources is sufficent to satisfy the scoping requirements.

6. INFRASTRUCTURE SYSTEMS COMPONENT

The information provided in the DPIR concerning infrastructure systems is sufficent to satisfy the scoping requirements, but for the following information which the FPIR must include: **1.4**

- Information on the differences between existing and proposed buildout conditions;
- Locations of hydrants (for tests);
- Description of BTE steam system service connections;
- Quantification of any water loss associated with cooling tower blowdown; and
- Evidence of correspondence with Boston Edison concerning the design of electrical vaults; and

The FPIR must also include a determination from the BWSC that the water and sewer facilities serving the existing facility are adequate to served the expanded facility.

B. AGREEMENTS

In addition to completing the Development Review Requirements process, the agreements, plans and documents listed below must be provided in form and content satisfactory to the appropriate signatory public agencies before building permits may be issued for the Project:

A) Development Impact Project (DIP) Agreement, including provisions for Jobs Contribution Grant and Housing Contribution Grant, pursuant to Articles 26A and 26B of the Code;

B) Transportation Access Plan (TAP) Agreement;

C) Traffic Maintenance Plan in conformity with the City's Construction Management Program;

D) Boston Residents Construction Employment Plan, pursuant to Chapter 12 of the Ordinances of 1986 of the City of Boston, as amended by Chapter 17 of said Ordinances, and Executive Order Extending Boston Residents Job Policy, signed by the Mayor on July 12, 1985;

E) First Source Agreement with the Mayor's Office of Jobs and Community Services; and

F) Amendment to the Sales Contract for the West End Project Area, entered into March 30, 1964, including such terms and conditions as the Director deems appropriate and in the best interest of the BRA.

2.0 BOSTON ENVIRONMENT DEPARTMENT, NOVEMBER 22, 1991

2.1 Availability of Parking Spaces for Volunteers

As noted in the Transportation Impact Analysis of the FPIR, the volunteers are individual Shriners who receive no compensation for their efforts. Most volunteers are not residents of the City and arrive during off-peak hours. When available, volunteers do park in the Board spaces in the Hawthorne Garage or Lomasney Way Garage.

2.2 Commitment to Transit Subsidies to Regular Staff

The level of subsidy to employees and construction workers will be equivalent to the formula being developed by the Massachusetts General Hospital. In addition, the Shriners Burns Institute will enter into an Agreement with the Massachusetts General Hospital to participate in their ridesharing/vanpooling programs and utilizing their shuttle service where possible.

Because of Shriners limited employee base, MGH agreed with the DEIR/DPIR's statement that the Institute would have limited success implementing its own independent commuter mobility program. However, the existing Affiliate Agreements between the two institutions makes it possible for Shriners to participate in MGH's program. MGH agreed to develop a proposal outlining the services that MGH could provide Shriners so that existing and future employees of the Institute can particpate fully in MGH's carpooling and vanpooling services. The Institute's commitment to ridesharing is proven by its proposal to construct five spaces in the new garage for use by ridesharing vehicles only. In addition, MGH would provide technical advice to Shriners for implementing a more effective transit pass program.

2.3 Commitment to Construction and Demolition Debris Recycling Program

The demolition contractor will be instructed to salvage such elements as brick, copper pipe, flashing and any other material resulting from demolition of the existing building to assure maximum recycling of construction and demolition debris.

2.0

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City of Boston
The Environment
Department

Raymond L. Flynn
Mayor

Lorraine M. Downey
Director

ston City Hall Room 805
ston, Massachusetts 02201
17 725-4416 or 725-3850

November 22, 1991

Secretary Susan Tierney
Executive Office of Environmental Affairs
100 Cambridge St. 20th Floor
Boston, MA 02202

Attn: William Gage, MEPA Unit
RE: #8688, Shriner's Burns Institute, Boston

Dear Secretary Tierney:

The City of Boston Environment Department has reviewed the Draft Environmental Impact Report/Project Impact Report for the proposed project referenced above and hereby submits the following comments in response thereto:

In general, the DEIR/DPIR adequately responds to the issues raised in the MEPA and BRA scopes issued on the project. The FEIR should refine a few points of concern, however.

Section 2.2.2 (p. IV-2.16) seems to contradict itself on whether parking spaces are available for volunteers. This paragraph should be clarified, and any impacts on need for garage space explained. 2.1

Section 4.2.1 (p. IV-4.1) claims that transit subsidies to regular staff will be investigated as a possibility in the future. The Environment Department would like to see a 2.2 stronger commitment to such a program in the FEIR. Section 4.3 mentions "provision of transit incentives" to reduce traffic impacts, but is not specific with respect to what form those incentives will take. The transit incentive program for construction workers described in section 9.7 will help mitigate one aspect of construction-period impacts.

The replacement facility will be lower or comparable in height to many buildings in the area, as reported in section 1.3.1, although it should be noted that the building will be higher than several of its immediate neighbors. Nonetheless, staff of the Landmarks Commission believes that the historic resources section adequately assesses project impacts on historic resources, and concurs with the findings in sections V-1.6 and 2.6 that shadow and wind impacts on historic properties have been minimized to acceptable levels.

Section 7.2.1 (p. V-7.1) implies that C&D debris will be recycled. The FEIR should firm up this commitment. The 2.3 addition of a recycling program in the new facility itself and the emphasis on source reduction (section 7.4) is laudable.

As described in section 8, the project is located in an area of relatively high ambient noise, much of which is attributable to HVAC and other mechanical sources on area rooftops. The project consultants have identified a number of steps which, when implemented, should help to lower mechanical noise sources associated with the Shriner's institute below current levels, and thereby contribute to an overall improvement in the community noise situation in the project area.

I thank you for your time and consideration.

Sincerely,

L M Downey

Lorraine M. Downey
Director

LMD/AP:ap

3.0 MASSACHUSETTS HISTORICAL COMMISSION, DECEMBER 4, 1991

The Massachusetts Historical Commission (MHC) stated that the reduction in height of the proposed project from 155 feet to 137 feet will minimize shadow impacts on the adjacent St. Joseph's Church and Rectory. MHC also stated that the project will have no effect on the significant and historical characteristics of nearby National Register and National Register-eligible buildings.

It should also be noted that the City's archaeologist has found no impact on archaeological resources in the local area resulting from the proposed project (see letter in Appendix A).

RECEIVED
DEC 19
MEPA

December 4, 1991

Secretary Susan Tierney
Executive Office of Environmental Affairs
100 Cambridge Street, 20th Floor
Boston, MA 02202

ATTN: William Gage, MEPA Unit

RE: The Shriner's Hospital for Crippled Children, 51 Blossom Street, Boston, MA; EOEA No. 8688

Dear Secretary Tierney:

Staff of the Massachusetts Historical Commission have reviewed the Draft Environmental Impact Report submitted to this office, received November 5 1991, regarding the proposed project referenced above. The proposed project, which involves the construction of a six-story addition to the existing four-story facility and an underground parking structure, is in the vicinity of multiple historic resources which are listed in or eligible for listing in the National Register of Historic Places.

MHC staff have reviewed the shadow study in the DEIR and have the following comments. The proposed new construction will create few new shadows affecting historic resources. In addition, the height of the proposed addition has been reduced from 155 feet to 137 feet, which will minimize shadow impacts on the adjacent St. Joseph's Church and Rectory.

Following review of this information, I concur that this project will have no effect on the significant and historical characteristics of nearby National Register and National Register-eligible buildings.

Massachusetts Historical Commission, Judith B. McDonough, *Executive Director, State Historic Preservation*
80 Boylston Street, Boston, Massachusetts 02116 (617) 727-8470

Office of the Secretary of State, Michael J. Connolly, *Secretary*

These comments are provided to assist in compliance with Section 106 of the National Historic Preservation Act of 1966, as amended (36 CFR 800), Massachusetts General Laws, Chapter 9, Sec. 26-27c, as amended by Chapter 254 of the Acts of 1988 (950 CMR 71.00), and MEPA.

If you have additional questions, please contact Allen Johnson of this office

Sincerely,

Judith B. McDonough

Judith B. McDonough
Executive Director
State Historic Preservation Officer
Massachusetts Historical Commission

cc: Boston Landmarks Commission
DEP, DWPC
Mitchell Fischman, HMM Associates, Inc.
Robert W. Curry, Widett, Slater & Goldman

4.0 BOSTON WATER & SEWER COMMISSION, DECEMBER 5, 1991

4.1 Water Conservation Chilled Water Return and Disposal

The refrigeration system, centrifugal water chillers and cooling towers, will be located at the proposed Shriners Burns Institute. The cooling tower will require a peak design capacity of 25 gpm for makeup due to tower blowdown and evaporation and drift losses.

4.2 System Connections - Sanitary and Storm Drains

Two sanitary and two storm drain connections will be made to the proposed building. The sanitary connections will be located near the building corner on Blossom Street and near the building corner on William Cardinal O'Connell Way. The storm drain connections will be located adjacent to the sanitary connections.

4.3 System Connections - Location of Steam Condensate Return Lines

The supplier of steam to the Shriners Burns Institute project has not yet been determined. The location of steam lines is unknown at this time.

4.4 Wastewater System/Mitigation Measures - Oil Separators

Approved API oil/water/sand separators will be installed in the underground parking garage.

4.0

**Boston Water and
Sewer Commission**

425 Summer Street
Boston, MA 02210-1700
617-330-9400
Fax 617-330-5167

RECEIVED
DEC 19
MEPA

December 5, 1991

Ms. Susan A. Tierney, Secretary
Executive Office of Environmental Affairs
20th Floor
100 Cambridge Street
Boston, MA 02202

Attn: MEPA Unit

Re: Shriners Burns Institute
Replacement Facility Project, DPIR/DEIR
EOEA #8688

Dear Secretary Tierney:

The Boston Water and Sewer Commission has reviewed the Draft Project Impact Report/Draft Environmental Impact Report for the Shriners Burns Institute Replacement Facility Project.

The Proposed facility will replace the existing facility. The number of patient beds will remain at the present 30. About 322 people will be employed at the facility. The proposed facility will be approximately 200,000 gross square feet (gsf) with an additional 70,000 gsf to provide below grade parking.

The estimate of sanitary flow from this facility is 24,400 gallons per day. Boston Thermal Energy (BTE) will provide building heating, humidification, hot water generation and instrument sterilization. Steam condensate will be returned to BTE so that steam will not be discharged to the sewers.

The following concerns should be addressed in the Final Environmental Impact Report.

1. Describe where and how much chilled water used for refrigeration will be returned or disposed of. **4.1**

2. Identify on a plan where separate sanitary and drain connections from the building will be located. **4.2**

3. Identify the location of steam condensate return lines. **4.3**

4. Oil separators will be required for the underground parking garage. **4.4**

Thank you for this opportunity to comment on this project.

Yours truly,

John P. Sullivan, Jr., P.E.
Chief Engineer

JPS/PK/mo

cc: S. Russo, Shriners Boston Burns Unit
Richard Mertens, BRA
Stephan Shea, BWSC
Patrick J. Foley, BWSC
Richard Kobayashi, MWRA

5.0 RAPPAPORT AND RAKOV, DECEMBER 5, 1991

5.1 Neighborhood Parking Impacts from Increases in the Number of Outpatient Visits

The DEIR/DPIR Scope required an analysis of peak hour impacts at four (4) critical intersections. The results of the analysis demonstrated negligible impacts. On a daily basis, the increase in outpatient services will generate an additional 60 trips (30 arrivals and 30 departures). Moreover, the neglible impacts are probably overstated since on-site parking has now been reduced by 50 spaces.

5.2 Occupancy by Shriners of Spaces in the Hawthorne Place Condominium Garage, and Current Vacancy During the Day

The Bruce Campbell Associates survey for the Hawthorne Place Condominium Trust identified only 104 spaces at the Hawthorne Place garage, yet analyzed occupancy using a total of 114 spaces. This results in lower than actual occupancy rates for the space. In addition, the survey failed to take into consideration the manner in which the spaces are assigned. The Shriners Burns Institute assigns parking spaces to an individual employee for a monthly fee. Therefore, an employee assigned to the evening shift would not arrive until after 12:00 Noon, while a night-shift employee would arrive after 10:00 PM (nurses working a double-shift would have their vehicles parking for some 16 hours). While the results of these shifts would appear to leave vacant space, the fact remains that the employee will be utilizing the space later than that day. As an example, an observation of spaces at 10:30 AM on December 12, 1991 indicated that 14 of 29 vacant spaces were assigned to employees working the night and/or evening shifts. According to the Institute's records, 36 employees work during these two shifts, which would account for the vacant spaces.

5.3 Assumptions of Parking Needs/Usages of Volunteers/Board Members and Auditorium Users

The DEIR/DPIR proposed a 122-space increase in total parking supply by maintaining only 99 off-site spaces while constructing the 150-car garage. The 249 spaces were to meet a demand for 265 cars. Section IV-3.2 in the FPIR includes new data on auditorium usage and demonstrates that the net demand is actually 343 parking spaces.

Despite this demand, the Shriners Burns Institute agrees with the city's overall goal of reducing the use of single occupancy vehicles by Institute employees, and is negotiating to reduce total on-site parking to 100 spaces. This on-site total has been presented to both the Boston Zoning Commission and the Zoning Board of Appeals. As demonstrated in Section IV-3.2, this smaller increase in on-site spaces can be accomplished by improving employee modal share and eliminating parking for the auditorium. However, a minimum of 70 spaces are required to meet projected patient needs. This assumes that outpatient growth will not exceed 75 patients/day. However, the expanded outpatient facilities will make it possible to schedule more patients at certain times, particularly if demand continues to grow. This demand is fueled, in part, by continued advances in medical technology which makes it possible to reduce hospital stays. This means that the inpatient becomes an outpatient sooner, and will require more extensive outpatient services. In order to account for additional growth in patient services, as well as meet conflicts in scheduling, it is now proposed that 15 parking spaces be designated as overflow spaces available for patient family members and visitors.

5.4 Consideration of Appropriate Mitigation Measures

Section IV-4.0 of the FPIR contains a detailed description of proposed mitigation, including transportation demand management techniques. In addition, the Shriners Burns Institute has proposed to increase its parking by only 100 spaces (not giving credit to the three existing on-site spaces).

5.5 Construction Period Traffic Management Plan

According to the Boston Transportation Department, MGH had not filed a Construction Management Plan (CMP) for Tower II at the time that the FEIR was filed. In addition, the closing of two lanes of Blossom Street in front of the Institute will be limited in duration to the time needed for steel erection in accordance with an approved CMP.

5.6 Impact from Service Area, Increases in Traffic, and Appropriate Mitigation

Currently, the Institute receives an average of sixteen (16) service deliveries daily. The majority of these deliveries (56%) are made by step-vans or smaller vehicles. These include food service, linen, courier services, medical supplies and mail. Of the remaining deliveries, 31% are by small trucks (such as milk deliveries) and 13% by 45-foot trailers.

At the present time, these vehicles are required to use the one loading dock located off William Cardinal O'Connell Way. Because of the limited access area, the larger vehicles tend to disrupt vehicular and pedestrian traffic along both William Cardinal O'Connell Way and the pedestrian way behind St. Joseph's Church. If a truck is already at the dock, other trucks are required to wait along William Cardinal O'Connell Way.

The proposed project will serve to mitigate these problems in a number of ways:

1) The new loading area will be enclosed and set back to allow trucks to enter without blocking vehicular and pedestrian traffic.

2) The service doors will mitigate noise and fume impacts to Regina Cleri, St. Joseph's Rectory, and William Cardinal O'Connell Way.

3) Additional loading docks will minimize, if not eliminate, the need for truck queueing along William Cardinal O'Connell Way. This is further reinforced by the elimination of the three parking spaces behind the existing building.

4) The increased storage space in the new facility will allow the Institute to store more supplies. This would mean that additional deliveries of supplies for increased outpatient services, medical research, and office space would not necessarily be required. In fact, the number of scheduled deliveries could,

potentially, be reduced due to increment storage capacity. Although additional waste will be generated by the new facility, the number of truck pick-ups is expected to be the same.

5.7 Conformity to West End Land Assembly and Redevelopment Plan

The proposed 137-foot height above-grade of the Shriners Replacement Facility is substantially lower than the 155-foot height limit contained in the West End Land Assembly and Redevelopment Plan, Proposed Zoning Plan, for the Shriners site, Parcel 8. Moreover, the current H-3 base zone has no height limit. Subdistrict M of the Downtown Interim Planning Overlay District specifies an as-of-right height limit of 125 feet and an enhanced limit of 155 feet. The Shriners Replacement Facility will be considerably lower than the 155-foot neighboring Hawthorne Condominium building and merely a fraction of the height of the nearby Longfellow Place buildings.

There is no specified limit on floor area ratio (FAR) in the West End Plan for public, semi-public and institutional uses. Moreover, it is apparent that the expected densities have been increasing since the 1957 Urban Renewal Plan. For instance, a 2.25 FAR was originally specified for residential buildings in the Urban Renewal area. Subsequently, the adoption of the H-3 zoning raised the FAR to 3.0. In 1971 the BRA approved an increase in FAR to 3.5 for Parcels 2-1E-1F in the West End Urban Renewal area under a provision permitting "minor" plan changes. In adopting this amendment to the Urban Renewal Plan, the BRA found that it does, "not substantially or materially alter or change the Plan". The growth of the West End and the nearby medical campus of Massachusetts General Hospital since the adoption of the Urban Renewal Plan and the 1971 amendments thereto suggest that the 4.5 FAR proposed for the Shriners Replacement Facility is not inconsistent with the West End Land Assembly and Redevelopment Plan as originally adopted and subsequently amended. The approval of Shriners' plans by the BRA Board, the Zoning Commission, the Boston Civic Design Commission and the Board of Appeals confirms this consistency.

5.8 Conformity to City of Boston Zoning Requirements

The underlying base zoning for the site is H-3, which under the Boston Zoning Code has no height limit and under the Interim Planning Overlay (IPOD) District has a proposed height of 125 feet which may be raised to an enhanced height limit of 155 feet. Shriners proposed height is entirely consistent with a long established pattern of municipal land use planning in this redevelopment area.

Moreover, while the proposed project would exceed the FAR of 3.0 in the base zoning, it will be well below the FAR of 8.0 more recently adopted by the IPOD for this zoning subdistrict and is, of course, immediately adjacent to Blackstone Apartments, which itself was the subject of dimensional zoning deviations (increasing its FAR to 4.41), which was granted by the BRA. In these circumstances, the BRA, as the planning and redevelopment agency of the City of Boston, is the appropriate body to determine the permissible FAR at the site in light of planning objectives and its experience over several decades in implementing the West End Urban Renewal Plan.

5.9 Increased Density (from 80,000 to 200,000 sf) and the Program Requirements of the Replacement Facility

The optimum programmatic requirements of the prototype Burns Facility call for approximately 235,000 sf (as evidenced in the new Galveston and Cincinnati units). Due to site restrictions and the desire by the SHCC to work within the context of the neighborhood, a reduction in program to 200,000 sf was proposed by the SHCC.

The existing facility, designed and constructed in the late 1960s, has long been inadequate for the facility's needs. All areas of the hospital have expanded in scope, and overcrowded conditions have resulted in temporary relocation of approximately 23,000 sf of research space to Cambridge (Kendall Square) and relocation of 3,600 sf of space to 90 Canal Street (medical records, business office, personnel quality improvement/risk management office). The redesign of the project in the DEIR/DPIR will require these off-site temporary locations until the completion of both Phase I and Phase II.

Increased research space is a small portion of the total new building increase. (Existing research space is approximately 16,500 sf, the proposed research space is 30,000 sf.) The research by the Shriners has produced many significant advances in burns treatment over the years, including the development of artificial skin and such medical programs as a "skin bank". These were wholly unforseen 25 years ago.

Advances in treatment of burns victims has resulted in shorter inpatient stays, with increased outpatient care for many years to follow. This shift has resulted in the need for improved and expanded outpatient care areas, but at the same time, has not resulted in the need to increase the number of beds.

The proposed facility is consistent with the allowed or permitted uses as described in the 1964 land purchase documents between the BRA and SHCC, which allowed patient care, research, and teaching type uses on the existing Burns Institute site.

5.10 Environmental Impacts from a Lower Building and Smaller FAR

A lower building is not possible due to the need for a Phase I medical/clinical facility which can function. Shriners has reduced the building mass and floor plate size from that in the PNF even though this will adversely affect efficiency. There are currently many patient care-related components that will not be in Phase I due to space restrictions due to the area reductions from the original PNF proposal. These include:

1) The Clinical Laboratory (blood testing of patients, etc.) and the skin bank will have to be located in Phase II. (These would ideally be located on the in-patient bed floors.)

2) Personnel and the Business Office will have to be located off-site until their location on the 3rd floor is complete (Phase II) as will storage facilities and research. Also, the Central Sterile area is one floor below surgery due to space restrictions (due to floor area) of the floor size. Surgery & Central Sterile are most efficient when adjacent on the same level.

Larger floor plates in Shriners Cincinnati and Galveston units allow more efficient facilities, as the critical functions can be adjacent to each other.

Preservation of light, air and open space is the purpose behind the curved facade on the southwest corner of the building. This allows for retention of views from the Blackstone and allows sunlight to reach the open space between St. Joseph's and Regina Cleri. Increased shadow impacts on the Church property has been shown to be minimal. This curve reduces the floor area from 30,000 sf (in the PNF proposal) to an average floor area of 21,974 sf, and, while reducing impact on the church property, it results in floor functional relationships which are less than ideal, as noted earlier. This curved design also places the facade of the building further away from the Blackstone Apartments than the side yard setback required by the Boston Zoning Code.

5.11 Consideration of Alternatives

The proposed Boston unit, at slightly under 200,000 square feet, will be approximately 30,000 square feet smaller than the equivalent Shriners Burns Units in Galveston and Cincinnati. Shriners has already reduced the Burns Institute to the essential square footage needed for a medical and research hospital of this kind. Moreover, the size and height of the building are chiefly a function of the need to build a new hospital facility while maintaining the existing hospital in operation. Only when the new hospital has been completed and furnished can the old one be demolished. Thus, the critical factor determining the height and size of the new facility is the need to build a replacement facility on top of the truss which will be built over the existing facility. Upon completion of the new hospital facilities above the truss, the entire functioning hospital operation will be transferred and the old building will be demolished. In fact, Shriners will locate approximately 23,000 square feet of research space off-site during the construction period at a cost of several million dollars. If the research space were to be built above the truss as part of Phase I, the building would necessarily be taller and have a higher FAR. By locating the research space and some administrative space off-site during the construction period, these functions can be brought back and located below the truss after the Phase II construction has been completed. The Phase I construction above the truss will have those essential hospital elements which cannot be moved off-site without impairing the functionality of the hospital unit.

The presence of underground parking on the new site will have no effect whatever on the size, height or mass of the building. Even without any parking on-site, the size of those floors above the truss essential to re-establish the hospital before the old facility is demolished will define the size and height of the building. The research, administrative, auditorium and parking space which will be built in Phase II below the truss will have no effect upon the size and mass of the building above the truss.

Thus, there is no effective alternative for Shriners to consider without discontinuing the provision of medical service to burn victims in the northeast region of the United States during the construction period; a limitation Shriners is not going to accept.

No replacement facilities are available at other locations. MGH does not have sufficient space available to house Shriners facilities during the construction period. Moreover, Shriners investigations of alternative sites have all proven fruitless. A site next to the Spaulding Rehabilitation Hospital lacked any connection to MGH, was needed by the MBTA and DPW for their purposes and was eventually taken in part by eminent domain and is also the site where Spaulding has since expanded itself. The Charles Street Jail site was investigated, but Shriners did not have sufficient land to swap for the jail and thus the site was acquired by MGH which did. A site owned by the BRA on Lomasney Way near the new Federal building was too distant from MGH to permit the immediate transfer of patients possible on the existing site because of the physical connection through the tunnel under Blossom Street. No other suitably sized sites adjacent to MGH were available for the Replacement Facility.

After investigating these sites and their problems, SHCC began to pursue options for expansion on their own property. Early studies included the following:

- Scheme 1 - Adding three levels to the existing building at the northwest corner;

- Scheme 2 - Adding extra floors of a size to match the existing building (with trusses to support new floors) with new elevators and stairs at corners; and

- Scheme 3 - The scheme as presented in the PNF.

Scheme 1 did not provide enough new area (the addition of 16,500 sf for a total facility of 96,500 sf) to adequately update the facility.

Scheme 2 provided proper area, but the existing floor area was not of sufficient size for department relationships. It also required 11 floors.

Scheme 3 presented the optimal floor area (30,000 sf) for departmental relationships. Five floors above the truss allowed all necessary components to be located in Phase I, requiring no temporary off-site relocations during Phase II construction. Parking was located above-grade in levels below the truss, a more economical and easier to construct alternative.

Neighborhood reaction to Scheme 3, when presented during meetings on April 22, May 17 and May 23, 1991 was negative. A series of design changes in response to the neighborhood input resulted in the proposal as presented in the DEIR/DPIR.

The presence of underground parking on the new site will have no affect whatever on the size, height, or mass of the building. Even without any parking on-site, the size of those floors above the truss, essential to re-establish the hospital before the old facility is demolished, will define the size and height of the building. The research, administrative, auditorium, and parking space which will be built in Phase II below the truss will have no affect upon the size and mass of the building above the truss.

Thus, there is no effective alternative for Shriners to consider without discontinuing the provision of medical service to burn victims in the northeast region of the United States during the construction period, a limitation Shriners will not accept.

5.0

LAW OFFICES OF
RAPPAPORT AND RAKOV

JEROME LYLE RAPPAPORT, P.C.
JANET F. ASERKOFF
EDWARD GILLIES

ONE LONGFELLOW PLACE
BOSTON, MA 02114
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DEC 5 1991
MEPA

DELIVERY BY HAND

December 5, 1991

Susan F. Tierney, Secretary
Executive Office of Environmental Affairs
100 Cambridge Street 20th Floor
Boston, Massachusetts 02202

Attention: MEPA Unit

Re: Shriners Hospital for
Crippled Children
EOEA No. 8688
Draft Environmental Impact Report

Boston Redevelopment Authority
Boston City Hall
One City Hall Square
Boston, Massachusetts 02201

Re: Shriners Hospital for
Crippled Children
EOEA No. 8688
Draft Project Impact Report

Gentlemen:

This office represents Prynne Realty Trust ("Prynne"), the owner of 44 condominium units at Hawthorne Place Condominium. Prynne has had the opportunity to review the comments to the above-referenced Draft Environmental Impact Report/Project Impact Report being submitted by the Trustees of Hawthorne Place Condominium Trust and supports all of the points made in the Trust's submission. In addition, as the single largest owner of condominium units at Hawthorne Place, Prynne is taking this opportunity to re-emphasize several of the points made by the Trustees. First, however, Prynne wants to express its support for the Shriners Hospital as part of the neighborhood, and its willingness to work with the Shriners to develop a plan for a building which will enhance the Shriners ability to deliver care, while not negatively impacting the neighborhood.

I. Parking

The parking analysis provided in the Draft Report inadequately analyzes the impact of the proposed facility, its program, and the proposed 150 parking spaces on the immediate neighborhood. The parking and traffic analysis has focused its attention on the major intersections, and appears to have concluded that the addition of 150 parking spaces will have no significant impact on the operation of major intersections during peak hours. Even if this analysis is correct, it fails to consider the programmatic parking impacts of the proposed facility. 5.1

Although the Shriners' will not be increasing the number of hospital beds, it will be significantly increasing the number of outpatient visits. The Draft Report indicates that currently no more than thirty (30) patients are seen three times a week whereas once the replacement facility is completed the Hospital anticipates that no less than seventy-five (75) patients will be seen on a daily basis. No attempt whatsoever has been made to assess the impact of this increased usage on the residential neighborhood adjacent to the Hospital. Shriners owns over 100 spaces in the Hawthorne Place Condominium garage,

directly across William Cardinal O'Connell Way from the Hospital. Approximately thirty-five percent (35%) of these spaces are empty during the day (see comments submitted by Hawthorne Place Condominium Trust). Thus, it would appear that a significant portion of 5.2
the alleged parking demand can be met without the addition of 150 parking spaces to the immediate neighborhood. This possibility has not been considered at all. This is an example of the failure of this Draft Report to adequately address the relevant issues. The Hawthorne Trustees have pointed out, and Prynne reiterates, other significant inadequacies in the parking analysis such as its assumptions of parking needs/usages of volunteers/board members and auditorium users, as well as its failure to adequately 5.3
consider appropriate mitigation measures. 5.4

It is disingenuous for the Draft Report to assert that the sale of parking spaces by the Shriners is a mitigation of the traffic impact. The parking spaces will still be in existence in the same location. A mere change in ownership will not affect whether parking spaces are or are not used. Therefore, the sale of existing parking spaces owned by Shriners does not lessen the impact of the addition of 150 parking spaces on the neighborhood.

II. Traffic Management During Construction

The traffic management plan during the construction period is wholly inadequate and unsatisfactory. Right now there is major construction at The Massachusetts General Hospital which is closing off at least one lane of the southbound side of a portion of Blossom Street. The Massachusetts General Hospital's construction will continue for several years. The Shriners' construction is estimated to take three years. During this time (which will overlap with The Massachusetts General Hospital's construction period) one entire side of Blossom Street will be closed off in front of the Shriners Hospital. All of the traffic travelling north on Blossom Street will have to move into one of the southbound lanes, and all of the southbound traffic will have to consolidate into one lane in order to pass the construction site. Four travel lanes will be reduced to two. This is merely stated 5.
as a fact and no attempt has been made to analyze the serious hardship this is going to have on the ability of residents to access Hawthorne Place, nor on the flow of traffic in the vicinity.

In addition, no attempt has been made to assess the impact of the construction management plan on the Shriners other immediate neighbors bordering on Blossom Street including The Massachusetts General Hospital, which operates a shuttle bus pickup and delivery service on the south side of Blossom Street, nor on the entry and exit to Emerson Place, a residential community with 460 apartments which is located on the north side of Blossom Street. The transportation management plan proposed for the construction period is thus totally unsatisfactory.

III. Shriners Hospital Service Traffic

The service area for the proposed replacement facility will be directly opposite the service entry for Hawthorne Place. This is the current location of the Shriners' service area and that may be the reason the Draft Report gives no consideration to the impact of the proposed replacement facility on the use of the service area, specifically on delivery of 5.
supplies and removal of wastes. The replacement facility will more than double the Hospital's space; outpatient visits will increase from thirty (30) vistis three times a week to

not less than seventy-five (75) visits daily, the number of employees will increase by almost twenty-five percent (25%). Prynne can only assume that the increased size of the facility and increased number of people using the facility will require more supplies and will generate more waste. An adequate Draft Report would have to set forth the expected traffic, analyze its impact and propose appropriate mitigation. This Draft Report does not even consider any of these issues. It is therefor inadequate.

IV. Height and Massing, the Floor Area Ratio (FAR)

The proposed height and massing of the replacement facility exceeds the allowed FAR for the lot. The Shriners Hospital attempts to focus on the fact that the height of the proposed building is lower than the height of Hawthorne Place. This limited comparison is **5.7** inappropriate. Hawthorne Place, on its land, is built to a FAR less than 3. Thus, Hawthorne's height is concentrated on a small portion of its property while the remainder of its property is open. Hawthorne Place, therefore, not only complies with the density requirements of the West End Land Assembly and Redevelopment Plan and with the zoning requirements of the City of Boston, but also creates a commodious pleasant, **5.8** uncrowded city environment.

When the Shriners built its first facility, it too complied with the FAR requirements, choosing to do so by building close to its lot line but keeping its building low. The proposed facility does not comply. The operation of the replacement facility does not require the density being proposed. The density is being increased from 80,000 square feet **5.9** to 200,000 square feet (plus 70,000 square feet below grade for parking) and appears to be driven largely by a desire for increased laboratory space. It is significant that the bed capacity of the Hospital is not being increased by the replacement facility.

Zoning requirements, in particular FAR in residential neighborhoods, are designed to facilitate the preservation of light, air, and open spaces. All of these goals will be negated if the Hospital is permitted to expand its size so drastically on its small lot. Although every effort has been made in the Draft Report to create the impression that the shadow effects, the wind effects, and the loss of views of the proposed facility will be minimal, no attempt **5.10** has been made to analyze these real and detrimental effects in terms of any alternative building which would have a different configuration. It is to be anticipated, however, that if the building were lower or had a smaller FAR, the negative wind and shadow impacts would be reduced, as would the limitations of view corridors.

V. Limitation of Analysis

The Draft Report has examined only the build and no-build situations; it has not considered any other alternatives. This is a significant limitation of the Report as a whole inasmuch as the need to reconfigure the patient care rooms in light of more modern technology might well be accomplished within a much smaller building. Since a smaller building, without parking spaces, would have significantly less severe impacts on the **5.11** community, the Shriners should be required to comply with MEPA regulations by considering alternatives.

Accordingly, Prynne joins the Hawthorne Place Trustees in requesting that MEPA and the BRA find the Shriners Hospital Draft EIR/PIR to be inadequate, and in requesting that MEPA and

BRA require the Shriners to prepare a supplemental or revised Draft EIR/PIR which addresses the issues raised in this letter and by the Hawthorne Place Trustees. It is Prynne's hope that in the process of preparing such revised or supplemental Draft Report, Shriners will choose to work closely with its residential neighbors so that the Hospital can speedily construct a replacement facility which will permit it to continue to provide excellent care to burned children, without having significant negative impacts on the neighbors.

Respectfully yours,

RAPPAPORT AND RAKOV

Janet F. Aserkoff

JFA/aeh

cc: Shriners Hospital
Eric Wodlinger, Esq.

6.0 NANCY BUEHLER, DECEMBER 5, 1991

6.1 Impact on Residential Neighborhood

Please see response to Comment No. 5.7.

6.2 Increase in Air Pollution

Under Department of Environmental Protection (DEP) guidelines, the Shriners Burns Institute project's impact on traffic is too small to require an air quality analysis. However, an air quality analysis was performed to examine the microscale impacts of the project on the worst potential area of air pollution in the project area. This analysis showed the project complied with Massachusetts and National Ambient Air Quality Standards (NAAQS) for Carbon Monoxide (CO). This project is a replacement facility, and attracts little additional traffic. In addition, the Shriners Burns Institute currently employs a number of transportation management strategies to reduce traffic congestion, hence air pollution. These include, e.g., flexible work schedules, Shriners plans to promote ridesharing and greater transit usage.

6.3 Size of Proposed Building

The current bed count of 30 has an occupancy rate of 80% (1992 census of SHCC). As burn injuries are impossible to predict, reducing the bed count only results in less capacity for those emergency situations requiring bed space.

The SHCC pursued temporary relocation with MGH. However, MGH responded that such space was unavailable (see Appendix A for copy of letter from MGH to SHCC). In fact, MGH is pursuing additional space itself. Moving to temporary facilities is a difficult task. A burns treatment patient room is much more complex than a typical hospital room. Strict humidity and temperature control, laminar flow air movement, bacteria control enclosures, etc., makes temporary relocation impractical to pursue. A "temporary" location becomes a fully constructed burns unit, built at great cost, which is not recovered. In addition. a large amount of highly tailored support space must also be provided.

Even if a move were feasible, building height would remain the same. A 200,000 sf building on the site will require 9 floors. Reducing the number of floors would require a larger floor area, resulting in smaller setbacks therefore decreasing open space around the site. The truss level would still be needed for mechanical space, even if the truss itself were not needed. A mid-location allows ducts to run up to upper levels and down to lower levels, therefore, reducing shaft sizes by 50% (compared to a basement or penthouse location), resulting in reduced area per floor.

6.4 Wind Tunnel Impact

Conditions at Stuart Street in Boston represent a much different situation than at the Replacement Facility. Notable windiness at Stuart Street is associated with the presence of the 800-foot Hancock Tower. Because this tall structure extends well above its surroundings, it is much more efficient at intercepting and redirecting higher speed, upper level winds toward ground level. The project site, however, is much different. The Replacement Facility is only 137 feet tall and more consistent with surrounding building heights. Therefore, similar conditions found at Stuart Street near the Hancock Tower are not expected with construction of the Replacement Facility. A location at the fringe of the project area which experiences similar effects as that of the Hancock Tower, however to a lesser extent, is at the Longfellow Towers. Around these buildings, windiness is apparent because these approximately 400-foot buildings extend above their surroundings. Because of their distance from the Shriners site, the Replacement Facility will not affect winds at the Longfellow Towers. The wind study concluded that with the project, winds will be no worse than a Category 3 (comfortable for walking).

6.0

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MEPA

December 5, 1991

Susan F. Tierney
Secretary of Environmental Affairs
Executive Offices of Environmental Affairs
The Commonwealth of Massachusetts
100 Cambridge Street
Boston, MA 02202

Dear Secretary Tierney:

In reviewing the proposed plans for the expansion of the Shriners Burns Institute, it appears that the serious harm to the present living environment will be caused which has not been realistically addressed.

The actual building plans with the truss and subsequent disruption to the area appear to deal with the problems this would create only superficially. The size of this presently proposed building is more in keeping with Massachusetts General Hospital than with the immediate residential neighborhood it finds itself in on this side of Blossom Street. Comparing its proposed size to that of Hawthorne buildings does not take into account the fact that our buildings have a very different FAR ratio and are balanced by trees and shrubs and space in keeping with a residential area. **6.1**

The quantity and magnitude of the problems raised by this proposal make it impossible to address all of the multiple problems the proposal itself creates without compiling an equally voluminous rebuttal. Therefore, this letter will mention only a few of the many catastrophic problems this size building and this size operation in this location creates--air pollution, wind tunnel, and the limited capacity for Cardinal O'Connell Way to handle the traffic this will undoubtedly create.

AIR POLLUTION

It has been disturbing and visually noticeable to those of us who are familiar with the Park, that in the last ten years the pollution level (when there is a low ceiling due to the Green House Effect) has increased visibly as well as to the olfactory sense--the air becomes unhealthy to breathe. The hospitals, industry and increased number of **6.2** cars are to blame for this already maximum problem. What is going to happen when more buildings are added to close in the area and more car exhaust and pollution are added to the formula. The Shriners proposal does not cover the amount of pollution they will add to the air. Couldn't these amounts be measured judging by their other operations around the country? When these are added to the figures of the air pollution in Boston on the days with "low ceilings," would the figure be still within the healthful range? Someone is going to have to take the responsibility for letting the situation get worse. Will the Boston Redevelopment Authority then go to the Shriners Burns Institute after construction and ask them to modify their operation because the actual damage was more than they had foreseen? What will the solution be then?

SIZE OF PROPOSED BUILDING

In the two meetings which Hawthorne Place residents the Shriner's representatives did admit that if it were not necessary to build with the truss the building would not have to increase as greatly as it would with the truss. Why can't the present number of patients--and if I understand correctly it is very rarely anywhere near maximum capacity
of 33--be relocated temporarily; any new patients in the **6.3**
Northeast could be cared for in their other facilities around the country. Then the present building could be removed and the whole process would be faster as well as it could be substantially downsized--or do they just want a large building?

WIND TUNNEL IMPACT

Stuart Street in Boston is a prime example of an area which is very difficult to walk on and almost impossible on windy days. That street is twice the width of Cardinal O'Connell Way and the "Street Wall" is much further apart than the proposed building would be from Hawthorne Place. Is it fair to the thousands of people who live in the two Whittiers, the two Emersons, the two Hawthornes, and the many patients that now come to this area and walk to downtown Boston,
Government Center, etc. to create a wind tunnel on Cardinal **6.4**
O'Connell Way and Blossom Street that will make the daily necessary and recreational walking a daily nightmare? Please check the uncomfortable walk which at present is very real when there are any winds at all in this general vicinity. How could this situation be remedied on Blossom Street and Cardinal O'Connell Way if this situation becomes worse not only for those above mentioned, but also for the handicapped who now use the street to get about in their

wheelchairs, the retired priests who take daily strolls, as well as the faithful who go to mass at St. Joseph's Church?

Secretary Tierney, we are not trying to stop the Shriner's from doing their work--it is very fine work--we just don't feel that they have to triple their size in this location, and add unnecessary parking and increased pollution to an already congested area--an area that was meant to be from its beginning--a residential area.

Ultimately, you, Secretary Tierney must answer to the environment, to future generations of residents of the West End who will continue to call this area home. Please do not let this unnecessary triple expansion destroy our environment as it stands. Another alternative could most certainly be found especially since the Institute has the resources. The fate and future of our homes and quality of life is in your hands, it is quite a responsibility.

Thank you for hearing me out.

Sincerely yours,

Nancy Buehler

(Mrs) Nancy Buehler
Nine Hawthorne Place
Unit 11/M
Boston, MA 02114

cc: Stephen Coyle, Director
Boston Redevelopment Authority

NB/cem

7.0 WIDETT, SLATER & GOLDMAN (ON BEHALF OF HAWTHORNE PLACE CONDOMINIUM TRUST), DECEMBER 5, 1991

7.1 Consideration of Alternatives

Please see response to Comment No. 5.11.

7.2 Consideration of Mitigation

Section V of the FPIR provides a discussion of mitigation measures for each of the impact areas.

7.3 Adequacy of DEIR/DPIR

All issues raised by both the Secretary of Environmental Affairs and the BRA have been addressed in the DEIR/DPIR and this FPIR. The Secretary has determined that the DEIR/DPIR adequately and properly complies with MEPA and its implementing regulations.

7.4 Construction Impact

It is anticipated that the construction period will last approximately three years. A Construction Management Plan (CMP) will be submitted to the City prior to the issuance of a building permit. The initial steps in the CMP process have started as described in our response to the Secretary's comments. As described in the FPIR construction impacts section, there will be some short-term impacts, but the CMP will ensure that the impacts are minimized to the extent possible. Hours of construction will be limited from 7:00 AM to 3:30 PM, Monday through Friday, although steel erection, foundation preparation, concrete pouring, and masonry work may extend to 5:30 PM on weekdays. Rather than using pile driving as described in the DEIR/DPIR, the foundation methodology will include a slurry wall thereby eliminating the need for any pile driving. FPIR Section V-9.0 includes a construction impact analysis and mitigation measures proposed to minimize any construction impacts.

7.5 Scale of Project

The proposed facility will not be "totally out of scale with its surroundings." The proposed 137-foot height is below the IPOD enhanced height of 155 feet. The West End Land Assembly and Redevelopment Project Plan shows that the proposed zoning plan called for a height limitation of 155 feet on the entire east side of Blossom Street (with the exception of the Blackstone School site). Specifically the site of SHCC was shown to have a 155-foot height limit. The underlying zoning is H-3 which has no height limitations.

The proposed facility is lower in height than the Hawthorne, Emerson, Whittier and Longfellow buildings in Charles River Park.

Care was taken not to further obstruct views to the southwest from Charles River Park by aligning the height of the new building with the height of the Wellman Building to the west. Taller buildings within the MGH campus range in height from 191 feet (Jackson Tower), 215 feet (Gray-Bigelow Building), 217 feet (White Building), 257 feet (Massachusetts Eye & Ear) to 345 feet (MGH inpatient care building).

7.6 Shadows on Vegetation and St. Joseph's Church and Regina Cleri Home

A vegetation evaluation has been conducted on the landscaped open space adjacent to, and in front of, Two Hawthorne Place and on the planted area along the western wall of St. Joseph's Rectory to anticipate shadow impacts during the Vernal Equinox (March 21). Shadow impacts were noted in the DEIR/DPIR for the Two Hawthorne Place's open space at 9:00 AM and 12:00 noon, and on a small portion of land adjacent to St. Joseph's Rectory at 3:00 PM (although it was also noted by the Secretary that there is reduction in shadows on St. Joseph's south side landscaped area due to the proposed building massing).

The evaluation indicates that the type of vegetation included in the Two Hawthorne Place open space includes a variety of ornamental trees and shrubs. On March 21, these plants and trees are in a dormant growth stage, or are just beginning to emerge from dormancy. This consideration, combined with the fact that the vegetation identified is primarily shade tolerant, means that the 2 to 4 hours of new partial shade on portions of this area during the Vernal Equinox should not impact the current growth cycle of these plants.

The vegetation along St. Joseph's rear wall also includes a variety of ornamental trees and shrubs. Only a portion of the northern edge will be in partial new shadow during the Vernal Equinox. No additional impacts to vegetation from the Replacement Facility are expected.

Please see Section V-2.0 for more detailed discussion of shadow impacts during the Vernal Equinox on these landscaped and vegetated areas.

7.7 Wind and Sunlight Impacts

The FPIR wind study conducted for the Replacement Facility indicated the following:

1) The proposed project, from a wind standpoint is consistent in height with other structures, so that the project's ability to redirect upper level, higher speed winds towards ground level is not significant. In addition, an extension of the building facade at the parapet level could further deflect pedestrian level winds.

2) Wind level categories under existing conditions for winter (northwest), summer (southwest), and storm (easterly) winds change little with the addition of the project. In all cases, levels are comfortable for walking.

3) The Replacement Facility is not expected to cause the BRA wind speed guideline of 31 mph (effective gust more than once per 100 hours) to be exceeded.

Therefore, the project is not expected to cause substantial wind conditions. (With regard to sunlight, please see response to Comment No. 7.6.)

7.8 Parking Garage and Traffic Impacts/No Change in Design from the ENF

According to Figures IV-3.3 of the FPIR, the project will increase morning peak hour volumes by 11 vehicles and the afternoon peak hour by only 19 vehicles. Neither volumes represent significant impacts.

There are many key differences between the original proposal in the ENF/PNF and the current proposal (as outlined in the DEIR/DPIR and FPIR). These changes were made in response to a series of meetings with the various abutter groups, as identified in Section II-7.0.

These include:

- Height reduction from 155 feet to 137 feet;
- Building width (on-street sides) reductions from 184 feet to 162 feet;
- Addition of setback on William Cardinal O'Connell of 19.6 feet (12.1 feet more than required setback of 7.5 feet);
- Shriners is negotiating to construct only 100 spaces under the building to respond to city and neighborhood concerns;
- South and east walls are curved to improve views (to the northeast) from the Blackstone and to provide additional sunlight to the St. Joseph's Church property. The curved shape in contrast to the original block shape also results in reduced shadow impacts compared to the PNF scheme because of increased setbacks with the building curve;
- Canopies have been added over the two entrances to mitigate wind conditins and a cornice has been added at the third floor;
- Exterior materials remain as masonry and glass;

- Building footprint is reduced from 30,000 square feet to an average floor area of 22,218 square feet, which allows for zoning setback conformity along Blossom Street and William Cardinal O'Connell Way;

- Existing trees may be relocated and replanted in the immediate area. Additional street tree plantings in the enlarged planned setbacks on three sides of the facility are proposed and four additional landscape options are being considered in the BRA design review process;

- Sidewalk and building lighting will provide a well illuminated pedestrian pathway along William Cardinal O'Connell Way and Blossom Street;

- Lobby functions on the first floor along William Cardinal O'Connell Way and Blossom Street will ensure an active "storefront" appearance along the sidewalk;

- The trellis and roof garden have been removed to further reduce obstructed views from neighboring buildings (this change has reduced overall height by 11 feet, from 148 feet to 137 feet);

- Ninth floor was set back, providing a terrace and, more importantly, a visual break at the top of the building in response to concerns about the apparent bulk of the PNF proposal;

- Cooling towers were relocated within the building to the truss level (Level 5) so as not to be visually obtrusive to the neighbors. Most exhaust will be directed onto Blossom Street and away from residential areas. A mechanical noise source from the roof of the building is thereby eliminated. Other exhaust is directed out the roof of the building;

- Patient elevator penthouse height has been lowered by 10 feet and the stair projections on roof has been eliminated which further reduces obstructions to views from neighboring hi-rise buildings;

- Several modifications have been made regarding vehicular circulation in response to neighborhood concerns. The parking garage entrance and exit has been relocated to Blossom Street. An earlier automobile drop-off on the north side has been deleted. It is now located within the building and accessed from Blossom Street. The new location of the drop-off reduces potential traffic on William Cardinal O'Connell Way, and reduces the number of required curb-cuts;

- Bus drop-off point along William Cardinal O'Connell Way has been eliminated; and

- Below-grade parking assures that the exterior walls will have windows facing onto occupied spaces rather than solid walls which would have been required to screen the cars. Service to the building remains in approximately the same location as the original building, using the existing easement with the Archdiocese.

7.9 Shriners Utilization of Parking at Hawthorne Place Garage

Please see our response to Comment No. 5.2. In addition, questions have been raised about patient parking in the Hawthorne Place Garage. No patient parking is provided in the Hawthorne Place Garage. The Hawthorne parking lot identified by family members is the commercial parking deck at One and Two Hawthorne Place.

7.10 Justification for New Garage

A review of the DPIR indicates that the existing conditions result in a shortfall of on-site, or controlled, parking by 79 spaces. Construction of the expansion will increase this shortfall significantly. However, rather than fully meeting this demand, the proponent is negotiating to increase parking by only 97 spaces resulting in a total supply of 224 spaces. Furthermore, almost 75% of these 97 additional spaces are necessary to meet the existing and projected needs of outpatients' family members and visitors to inpatients.

7.11 Traffic and Parking Mitigation Analysis

The analysis contained in the DEIR/DPIR indicates that both the Fruit Street and Parkman Street MGH garages had occupancy rates over 90%, with the Ambulatory Lot serving as an overflow facility for MGH outpatient services. In fact, with an overall capacity of 86%, the overall off-street parking supply in the area is nearing effective capacity. On-street parking is already at capacity (see Section IV-3.2).

MGH's plans for constructing 100+ additional parking spaces at the site of the former Charles Street Jail is a temporary measure designed to meet shortages created when MGH's Nashua Street lot was closed. (The lot was closed as part of the land swap with the Commonwealth for the construction of the new Suffolk County Jail.) The Charles Street Jail lot will be closed when MGH redevelops the site in the future.

7.12 Truck Traffic Generated During Construction

The number of trucks during the construction period will vary. On average, over the course of the demolition and construction phase, truck volumes of 10 to 12 arrivals and 10 to 12 departures per workday are expected. Assuming an even distribution over an 8-hour day, this translates into approximately two arrivals and departures per hour. The traffic impacts of these trips is expected to be negligible. However, it is possible that the volume of trucks will increase when concrete pouring begins.

7.13 Shadow Impacts on Surrounding Vegetation

Please see our response to Comment No. 7.6.

7.14 Impact on Vegetation and Increased Daylight Obstruction

Please see response to Comment No. 7.6 for a discussion of the analysis on vegetation completed in the FPIR. An additional daylight viewpoint location was analyzed along the rear access of the facility. The results shows that daylight obstruction at that location will only increase from 36.8% to 52.1%, a difference of 15.3%.

7.15 Wind Impacts at Intersection of Blossom Street and William Cardinal O'Connell Way as a Result of Project

The DEIR/DPIR wind study indicated that under northwest winds the Replacement Facility will probably bring higher speed winds to the ground along its walls. These increases, however, as noted in the DEIR/DPIR figures and described further in the text, are not expected to worsen conditions since a Melbourne Category 3 level (comfortable for walking) will be maintained.

Wind conditions in general will change little. The results of the DEIR/DPIR wind study indicate no location with a category worse than that classified as comfortable for walking (Category 3).

In the area of the St. Joseph's Church and Regina Cleri House, conditions under winter, northwest winds will likely improve due to the sheltering of the Replacement Facility. For the warmer southwest winds some increases may occur along the pathway between these two buildings, however, levels are expected to remain at Category 4 (comfortable for short periods of standing or sitting). For winds with an easterly component, the pathway between the St. Joseph's Church and Regina Cleri House may improve. Otherwise winds around these two buildings will remain unchanged. Therefore, the project will likely provide more wind benefits around these buildings than not.

7.16 Consideration of Alternatives

Please see our response to Comment No. 5.11.

7.17 Conformance with Article 31

The DEIR/DPIR was completed in accordance with the BRA's Scoping Determination pursuant to Article 31, which was determined to be adequate by the Secretary. Please see our response to Comment No. 5.11 for additional discussion of alternatives.

7.18 Review of Type of Construction to be Carried Out (i.e., Truss Technique)

Early studies of the truss explored ways to reduce the truss depth by placing intermediate columns through the existing building, using mechanical or stair shafts that are continuous through the building. It was determined that this would be very difficult to do from a construction standpoint and possibly create conflicts with hospital operations.

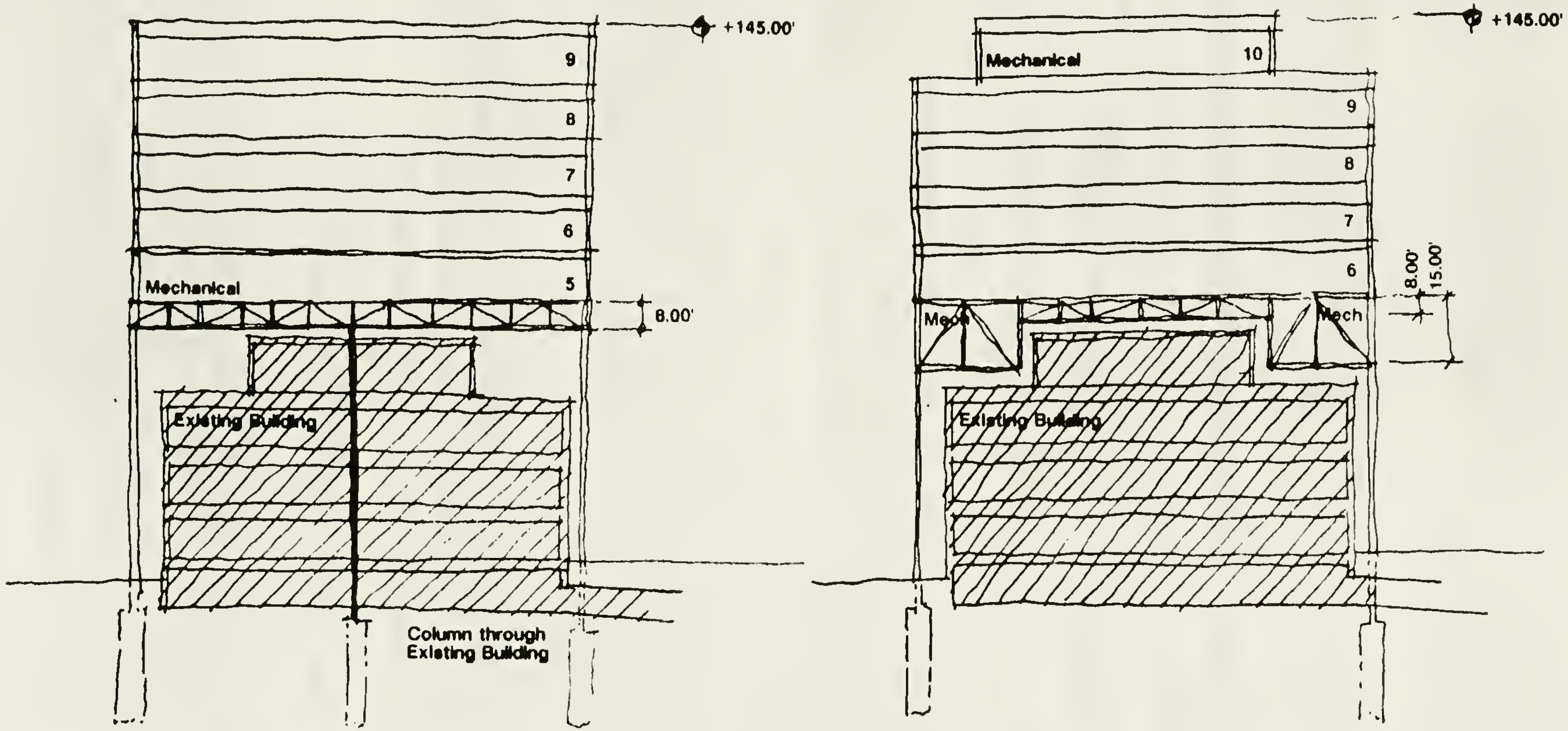
More importantly, a lower truss depth would render the truss level unusable for mechanical equipment, thereby creating the need for another floor to house that equipment (see Figure IX-7.1 for illustration of alternative truss techniques explored during the design process).

7.19 Temporary Relocation to MGH

The SHCC pursued temporary relocation with MGH. However, MGH responded in writing that such space was unavailable (see Appendix A for copy of letter from MGH to SHCC). In fact, MGH is pursuing additional space itself. Moving to temporary facilities is a difficult task. A burns treatment patient room is much more complex than a typical hospital room. Strict humidity and temperature control, laminar flow air movement, bacteria control enclosures, etc., makes temporary relocation impractical to pursue. A "temporary" location becomes a fully constructed burns unit built at great cost, which is not recovered. In addition, a large amount of highly tailored support space must also be provided.

7.20 Utilization of Nearby Parking Spaces to Eliminate Need for Subsurface Parking Structure

The driving forces behind the Shriners Burns Institute's need for 100 on-site parking spaces are patient care and maintenance of an adequate supply to meet future patient needs. Because of the nature of burn injuries, a burn patient faces physical, as well as psychological impediments to using transit, and faces physical impediments to having to walk a long distance from a garage. Location of the garage in the structure will enable staff to receive an outpatient at the



Truss Study A

Truss Study B

6004

FIGURE IX-7.1
ALTERNATIVE TRUSS TECHNIQUES

Motor Lobby entrance while a parent or caretaker parks in the garage. In this manner, the child is not subjected to the elements, and can be reunited with his/her family quickly.

A minimum of 70 spaces in the garage are directly needed for patient use. The remaining spaces in the garage will accommodate evening and night-shift employees, employees who rideshare, and a limited number of key staff. However, as the need for additional patient parking increases, the employee parking will be reduced.

7.21 Comparison of Proposed Height to Towers at MGH

The comment that the building will "add significant mass and height to the site, resulting in a building comparable in height to the towers at MGH" is inaccurate. The height of 137 feet for the proposed facility places the building at the same height as the MGH Wellman Building, so that views to the southwest (towards the Charles River) are not obstructed more than the Wellman Building currently obstructs those views.

Other "towers" of MGH are much higher than the proposed Shriners facility. These include the Jackson Tower at 191 feet and Gray-Bigelow Building (215 feet), new inpatient care building (345 feet), Mass. Eye & Ear (257 feet) and the White Building (217 feet).

7.22 Issues of Alternatives, Mitigation Measures, Wind, Shadows, Vegetation Impacts, Pedestrian Environment, Need for Parking Garage and Alternatives to Garage, and Alternatives to Truss Method of Construction

a. Please see our response to Comment No. 5.11.

b. The FPIR included a detailed discussion of mitigation, particularly as it applies to transportation and parking issues. The proponent is committed to striping crosswalks across William Cardinal O'Connell Way and Blossom Stret; has identified improvements to William Cardinal O'Connell Way for future consideration by the City; will implement a commuter mobility program in cooperation with the Massachusetts General Hospital; and has reduced the garage by 50 spaces. In addition, the proponent is negotiating a total supply of 224 spaces, 124 off-site, rather than the 249 proposed in the DEIR/DPIR.

c. Please see our response to Comment No. 7.6 and more detailed analysis in Section V-1.6.

d. The level of subsidy to employees and construction workers will be equivalent to the formula being developed by the Massachusetts General Hospital. In addition, the Shriners Burns Institute will enter into an Agreement with the Massachusetts General Hospital to participate in their ridesharing/vanpooling programs and utilizing their shuttle service where possible.

Because of Shriners limited employee base, MGH agreed with the DEIR/DPIR's statement that the Institute would have limited success implementing its own independent commuter mobility program. However, the existing Affiliate Agreements between the two institutions makes it possible for Shriners to participate in MGH's program. MGH agreed to develop a proposal outlining the services that MGH could provide Shriners so that existing and future employees of the Institute can participate fully in MGH's carpooling and vanpooling services. The Institute's commitment to ridesharing is proven by its proposal to construct five spaces in the new garage for use by ridesharing vehicles only. In addition, MGH would provide technical advice to Shriners for implementing a more effective transit pass program.

Also, please see our responses to Comments 5.4 and 7.12.

e. Earlier studies of the truss explored ways to reduce the truss depth by placing intermediate columns through the existing building, using mechanical or stair shafts that are continuous through the building. It was determined that this would be very difficult to do from a construction standpoint and possibly create conflicts with hospital operations.

More importantly, a lower truss depth would render the truss level unusable for mechanical equipment, thereby creating the need for another floor to house that equipment (see Figure VII-7.1 for illustration of alternative truss techniques explored during the design process).

WIDETT, SLATER & GOLDMAN, P.C.

HAROLD WIDETT
CHARLES M GOLDMAN
JEROME MEDALIE
MARSHALL [illegible]
HAIG DER MANUELIAN
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December 5, 1991

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BY HAND

Hon. Susan F. Tierney
Executive Office of Environmental Affairs
100 Cambridge Street, 20th Floor
Boston, MA 02134

RE: EOEA No. 8688, Shriners Project

ATTN: William T. Gage, MEPA Unit

Dear Secretary Tierney:

On behalf of the Hawthorne Place Condominium Trust, we are providing the following comments on the Draft Environmental Impact Report prepared by the Shriners Burns Institute ("Institute" or "Proponent").

For the reasons discussed in detail below, we believe that the Draft EIR is not "adequate" for purposes of the MEPA regulations, at 301 C.M.R. 11.08, and that a supplemental or revised Draft EIR should be prepared to address the deficiencies in the Draft. A copy of these comments is being provided to the Boston Redevelopment Authority pursuant to Article 31 of the Boston Zoning Code.

A. Overall Comment

Under the MEPA regulations a Draft EIR is required to address alternatives to the proposed project which will cause the least impact to the environment. 301 CMR 11.07(4). In addition, in the Certificate dated June 21, 1991, the Secretary

required the Proponent to respond to the numerous comments made
by abutters and other concerned parties which stressed the
total absence of consideration of alternatives to the Project
as proposed, and the failure to consider significant mitigation
measures for the Project. The Secretary specifically asked 7.1
that the Proponent address several issues: wind and shadow
impacts, including the effect of decreased sunlight and
increased wind on trees, shrubs and vegetation; adverse impacts 7.2
of shadowing on surrounding historic buildings and design of
other mitigation measures to limit or minimize such adverse
impacts; and, of course, traffic and parking issues.

Unfortunately, the Draft EIR does not meet these
mandates. Principally, it does not adequately consider the
traffic and parking issues, particularly alternatives to the
proposed 150 space garage; inadequately addresses the wind and 7.3
shadow impacts of the project, particularly on vegetation;
barely describes mitigation measures; and fails altogether to
address any meaningful alternatives to the planned construction.

The Institute proposes to construct a 137 foot tall
building of 9 stories (plus "roof gardens" and elevator
penthouses) with an underground parking garage of 150 spaces on
a small site in the West End. This will more than double the
current hospital's mass and height and add 147 new on-site
parking spaces. Further, the Proponent intends to construct
the new facility in phases by means of a truss on top of the
existing 4 story building, followed by demolition of the first
four floors and construction of the underground parking and new
floors. This will impose a three year or more construction 7.4
project with unavoidable negative impacts on the surrounding,
largely residential area. The new building will be totally out
of scale with its immediate surroundings. It will cause 7.5
significant shadowing of vegetation and on the adjacent
historic St. Joseph's Church and Regina Cleri Home. It will 7.6
cause substantial wind conditions, and will have a dramatic
impact on availability of sunlight. And the parking garage 7.7
will generate in the immediate area of the new facility
increased traffic which will only add to the already congested
traffic situation in this area. 7.8

It is extremely disappointing to the Project's abutters that the Institute has chosen to publish a document which simply seeks to rationalize a previously-made decision to amass a new facility at this site which is virtually the same in all important respects as the one originally proposed during the

ENF review. The current project, as did the original proposal, would more than double the program square footage (increase to 200,000 square feet from the present 80,000) and would increase the height of the present building by more than 130 percent. In order to accommodate this substantial expansion on a parcel of under 40,000 square feet in area, the Institute's has proposed a building with virtually no setbacks or landscaped areas, based on a site design completely contrary to the setbacks and landscaping which prevail throughout Charles River Park. Moreover, the extremely expensive and time consuming method which the Institute has chosen to construct the Project will definitely cause severe impacts on the surrounding neighborhood and along Blossom Street.

As a result of insisting on this approach, the Institute has failed to consider alternatives to this $45 million plus project as planned and has inadequately addressed the impacts of the project and the measures to limit or mitigate those impacts. The Draft EIR must be supplemented or revised with a serious discussion of those issues, in order to permit a meaningful process from this point forward.

B. Specific Comments

1. Traffic/Parking

The discussion in the Draft EIR of the need for the planned 150 car parking garage is woefully inadequate. It overstates the current and future parking needs of the hospital, fails to consider other parking alternatives in the area, fails entirely to disclose that current spaces owned or controlled by the hospital are substantially underutilized, and does not fully address the necessity for avoiding or mitigating further encouragement of private automobile trips. In support of this comment, please see the report dated December 4, 1991 of Bruce Campbell and Associates, attached as Exhibit A. **7.9**

The Project Proponent has not established, through the analysis in the Draft EIR, a convincing case for the new garage. Given the prominence of the parking garage as an element controlling the siting and design of the proposed new facility, this failure alone requires rethinking the entire project and should be followed by publication of a revised Draft EIR. **7.10**

The draft EIR states that without the new garage there will be a shortfall of 138 spaces (see page IV-3.17). It bases this total on assumptions about usage by volunteers, Board members, employees, outpatients and other visitors. Many of these assumptions appear to be highly questionable.

For example, the Draft EIR indicates that volunteers are users of the existing 124 off-site spaces and 3 on site spaces, but then counts the volunteers as new users for purposes of the parking need analysis. Draft EIR, pages IV-2.16-2.17.

The Draft EIR further assumes that 40% of the Board members are at the hospital every day (page IV-2.17). This assumption does not appear to be based on the results of any survey or other reliable information. Further, to what extent are the Board members and volunteers one and the same for purposes of counting parking needs?

As another example of the inadequacy of the parking analysis, the Draft EIR states that 25% of the Institute's auditorium users (49) will need parking, yet it also indicates that the seats are used only 54% of the time and are used by both MGH and Shriners' visitors. Without an analysis of the parking alternatives available to MGH visitors, the assumption that the auditorium users will require additional parking at the Shriners' site is questionable.

Equally troubling is the fact that the new garage most certainly is being constructed to accommodate employee demand. It may be recalled that during the ENF phase of this review, Shriners Institute assured EOEA that employees at the site would remain in the current range of 250 to 270 employees. However, the DEIR states that the number of staff at the site will rise by more than 60 employees, or nearly 25 percent. Moreover, most of these will be part of the first or day shift, which represents an increase of more than 33 percent. Accommodating these employees, together with existing staff, with a parking space at the site is simply contrary to state and local policy as a matter of both transportation and environmental concerns, including compliance with the 1990 Clean Air Act Amendments.

The attached Report by Bruce Campbell and Associates ("BC&A") indicates that the Shriners are not presently using all the parking capacity presently available to them. Based on a survey of existing off-site spaces available to the Shriners at Hawthorne Place (114), approximately 35 percent on average were unoccupied during the day, and between 60 and 85 percent were unoccupied during the evening. BC&A concludes that under existing conditions, the Shriners' spaces are underutilized. Thus, the Proponent's assertion that they presently have a serious parking deficiency appears suspect. Since the case for the parking garage is premised on present need, the whole analysis is seriously flawed.

The traffic and parking mitigation analysis in the Draft EIR is also inadequate. It consists of a statement that the Shriners will reduce their off-site parking needs from 124 to 99 by various means such as ride-sharing and encouragement of mass transit. Even if we were to ignore the fact that mitigation of this type is probably required in any case both to meet the new deadlines for attainment of the standards for ozone and carbon monoxide under the revised Massachusetts State Implementation Plan, and in light of City of Boston policies restricting conditional use permits for expanded parking in areas served by transit, there simply is no discussion of other mitigation possibilities. For example, MGH has significant parking capacity and has plans to construct new parking in the near future. There are also additional public and parking supplies that are available in the area. See the Report of Bruce Campbell & Associates in this regard. The Draft EIR fails to address this additional resource in analyzing the Shriners' projected parking needs. Other mitigation measures are also not addressed, for instance, increased use of Shriners' vans to carry outpatients comfortably back and forth to the hospital, and further encouragement of mass transit use by Board members and employees, including its researchers whose travel demands should be among the most flexible of those using the Institute. **7.11**

Also of direct concern to the Shriners' neighbors is that the Draft EIR simply is silent on the issue of truck traffic to be generated during construction and after Project completion. One cannot have a more than doubling of outpatient/clinic activity and a significant increase in employees at an institution of this kind and not have a significant increase in truck deliveries and loadings, including solid and toxic waste transfers. All these are purportedly to occur at the narrow and crowded private alley serving the Regina Cleri Home and St. Joseph's Church, and are to be accessed off William Cardinal O'Connell Way at a location directly opposite the loading docks for Hawthorne Place. Nor **7.12** is there any consideration of how this increased truck activity will impact on pedestrian traffic or accidents in this immediate area which is heavily used for foot traffic.

2. Shadowing, Wind and Loss of Daylight

The Secretary's Certificate dated June 21, 1991 specifically required that the Draft EIR address effects on the surrounding vegetation and historic structures, the effects of wind and loss of light on residents and pedestrians, and appropriate mitigation measures to deal with the impacts. The Draft EIR does not adequately address those issues. To the extent that it does address them it is clear that the impacts are quite severe and that adequate mitigation measures have not been considered.

The analysis offered in the Draft EIR states that at certain times of the year, notably in the spring and fall, there will be increased shadowing on surrounding vegetation as **7.1** well as on the adjacent historic St. Joseph's Church. During the vernal equinox, the Linden trees on the Hawthorne Place Property across William Cardinal O'Connell Way will have 3 additional hours of shade as a result of the proposed construction of the new 137 foot building. Further, during the winter solstice, shadows on 2 Hawthorne Place will increase from 17-88 vertical feet at noon and 33-104 feet at 3 p.m. At 3 p.m. at the vernal equinox new shadow will cover the west side of St. Joseph's Church which has a lovely set of trees on that side. Draft EIR, pages V-2.1-2.3.

The Draft EIR gives short shrift to the effects of this shadowing. Regarding the effect on the Hawthorne Place vegetation, for example, it states that such shadowing will "not cause severe stress, because not all of the described trees will be in complete shadow." Draft, page V-2.2. Similarly, with respect to the increased shadowing on William Cardinal O'Connell Way, the Draft states that the effect is "expected to be minimal, particularly since the vegetation will be going into the dormant phase during this period." Draft, page V-2.3. The Draft EIR notes that St. Joseph's church is an historic structure listed on the Inventory of Historical and Archaeological Assets of the Commonwealth and that there will be significant shading of the west (facing) side of the Church during the vernal equinox. However it fails to address this problem or the prospect that the trees and vegetation planted on the west side will be affected (see photographs attached to our comments on the ENF).

These conclusory statements are no substitute for a thorough analysis of the effects on the surrounding vegetation and historic structures required by the Secretary's Certificate. Further, there is no discussion of possible mitigating design or other measures which could be taken to limit or mitigate these effects.

Similarly, the Draft EIR notes that the proposed project will cause a severe loss of sunlight, but fails to address the impacts on vegetation and possible mitigating measures which could be taken. Draft, page V-3.7. According to the Draft, "daylight obstruction" on Blossom Street would increase from 18.4-71.3%; on William Cardinal O'Connell Way, the increase would be from 25.8-79.4%. While the Draft EIR attempts to undermine its own study as limited and unrealistic, those limitations are built into the analysis model and the results speak for themselves. **7.14**

The wind effects of the proposed structure having a 130% increase in height and dense mass facing Blossom Street and O'Connell Way are also dismissed as negligible in the "Wind Qualitative Assessment" at Section V-1.0. However, the document does state that winter winds caused by the replacement facility will in fact worsen conditions at the intersection of Blossom Street and O'Connell Way as a result of the height and massing of the Proponent's design. See page V-1.21. Winds during other seasons will also increase at various points in the area, including at St. Joseph's Church and Regina Cleri Home. **7.15**

The upshot is that the planned 137 foot new building will result in a significant loss of sunlight to residents and pedestrians in the vicinity of the building and will cause a significant increase in shadowing and wind impacts. What is currently a fairly attractive building of reasonable scale in terms of its surroundings will become one more towering building that will detract from the ambience of this remaining oasis in the West End, and create the canyon along Blossom Street's east side that planning for the West End clearly sought to avoid. The Proponent should be required to clarify these impacts and then to prepare serious mitigation strategies to address them.

3. Consideration of Alternatives

As noted earlier, the problems just described are a direct result of the Shriners' total unwillingness to give serious consideration to alternatives to the building program and facility design which they have insisted upon for this site.

Indeed, it merits emphasis that at no point in the review process, whether in or out of the EIR, have the Shriners considered alternatives. The Draft EIR makes this abundantly clear at page I-3, where it is simply asserted that the Shriners have "explored" alternatives to siting the expanded facility at the Blossom Street parcel, and have "determined that building on their existing site was the best option [because] [i]t allows the hospital to maintain its physical link (through an existing tunnel) with the Massachusetts General Hospital, which permits the rapid movement of patients between the hospitals to provide specialized treatment facilities as needed to patients at both hospitals." **7.1**

This attempted rationalization of the Institute's failure to consider alternatives to the present building program and design is especially troublesome to Hawthorne Place and other neighbors. The neighbors are already living with the impacts of dense institutional development at the MGH core west and south of Blossom Street. At the same time, there is not a shred of evidence to suggests that Shriners have discussed with MGH the possibilities of sharing resources or services, whether temporarily during construction, or on a permanent basis, in order to mitigate the effects of the current proposal. Given the substantial planning underway at MGH for development of its complex, including additional parking resources, and in light of the fact that mitigation measures attendant on such development must be developed, surely the Shriners should be asked, on the basis of their "close" relationship physically and functionally with MGH, to work out a coordinated plan for development which accords appropriate balance between planned expansion and the residential neighborhood.

Although not explicitly stated in the document, it may be that the Shriners are seeking to avoid discussion of alternatives by hiding behind the language of the Scoping Determination issued by BRA for this project under Article 31 regarding consideration of alternatives as a "prelude" to evaluation of urban design issues.[1] If this is the Shriners' view, it is misinformed, because even under Article 31, evaluation of alternatives is required. In any event, it is beyond dispute that the failure to evaluate alternatives is directly contrary to the basic requirements of Sections 61 and 62 of MEPA, and is not consistent with the requirements embodied in the Secretary's Certificate of June 21, 1991. **7.17**

4. Method of Construction

Because the Proponent plans on building a nine story building with abundant onsite parking, it proposes to build it in phases, using a complicated truss technique. The result will be a 3+ year construction project which will be highly disruptive to traffic and to the residents of the area.

It may be that the considerable expense entailed by this type of construction is of no consequence to the Shriners, who have access to capital financing which was not disclosed in the Draft EIR or in response to the requirements normally imposed on Boston developers under BRA's Article 31 review process (see page II-5 of the DEIR in this regard). Regardless, the Secretary as well as the BRA should require the Shriners to rethink the type of construction to be carried out on this site, which is quite small and severely constrained on the southern, eastern and northern edges due to the close proximity of the Blackstone Housing, Regina Cleri Home, St. Joseph's Church, the narrow William Cardinal O'Connell Way, and Hawthorne Place. **7.18**

Once again, the Institute apparently did not consider and certainly has not discussed in the Draft EIR the option of relocating temporarily the Institute's thirty-bed facility to nearby facilities within MGH. This option would permit controlled demolition and rebuilding within the current Shriners parcel. This would avoid entirely the complicated **7.19** truss method, and in all likelihood, permit a far less costly and more accelerated construction sequence. If combined with utilization of parking spaces nearby rather than construction of a subsurface parking structure, it would more than likely result in a less dense and complicated new building that could be constructed more efficiently in the interests of all concerned. 7.2

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[1] The BRA's Scoping Determination provides at page 10 as follows: "As a prelude to the discussion of urban design issues related to the Proposed Project, the Proponent is requested to provide narrative information on: (1) the need for the Proposed Project; (2) consideration given to alternatives to the Proposed Project; and (3) consideration given to alternative locations for the Proposed Project."

C. Conclusion

The current Shriners Institute is a reasonable neighbor. It is located in a particularly attractive area of the West End which is home not only to medical institutions but also to in-town residents. At its present scale it complements but does not threaten the surrounding historic structures and residential units. The proposed project, however, will add significant mass and height to the site, resulting in a building comparable in height to the towers at MGH. Further, the Shriners will add a major onsite parking facility, where at present it has 3 onsite spaces. As the draft EIR suggests, however dismissively, the effects of wind, shadowing and loss of light on surrounding vegetation and historical structures and the residents and people who use them will be substantial. The means of construction dictated by the size and configuration of the proposed project will result in a significant, lengthy and disruptive construction process. 7.2

We are not opposed to a modest expansion of the Shriners Institute. However, any such expansion must be planned in a manner which respects that it is located in the middle of a residential area on a small parcel on which only limited institutional development is appropriate. If the approach taken to date by the Proponent is not corrected through preparation of a revised or supplemental Draft EIR which sets forth real alternatives to the current proposal, the value of the Final EIR in achieving and documenting essential mitigation for an urban institutional development of this kind will be all but negated and the process effectively brought to a premature close.

Therefore, pursuant to the MEPA regulations at 301 CMR 11.08, we urge the Secretary to find that this Draft EIR is inadequate in at least the following respects, and to require that the Proponent prepare a supplemental or revised Draft EIR to address these issues:

a. No discussion of feasible or practicable alternatives to the Project as proposed.

b. Inadequate discussion of mitigation measures.

c. Inadequate discussion of effects of wind, shadowing and loss of light on surrounding vegetation, historic St. Joseph's Church, on the Regina Cleri Home, and the pedestrian environment in this immediate area. **7.22**

d. Inadequate consideration of need for the 150 car parking garage or of feasible alternatives, including increased use of mass transit and other alternatives to private automobiles.

e. No discussion of alternatives to the truss method of construction.

Thank you for your courtesy in reviewing our comments through the MEPA process.

Sincerely,

WIDETT, SLATER & GOLDMAN, P.C.

Robert W. Curry
Kenneth A. Reich

cc: Stephen Coyle, Director,
Boston Redevelopment Authority
1454t

8.0 BRUCE CAMPBELL & ASSOCIATES, DECEMBER 4, 1991

8.1 Parking Survey Results at Hawthorne Place Garage

The Bruce Campbell Associates survey for the Hawthorne Place Condominium Trust identified only 104 spaces at the Hawthorne garage, yet analyzed occupancy using a total of 114 spaces. This results in lower than actual occupancy rates for the space. In addition, the survey failed to take into consideration the manner in which the spaces are assigned. The Shriners Burns Institute assigns parking spaces to an individual employee for a monthly fee. Therefore, an employee assigned to the evening shift would not arrive until after 12:00 noon, while a night-shift employee would arrive after 10:00 PM (nurses working a double-shift would have their vehicles parking for some 16 hours). While the results of these shifts would appear to leave vacant space, the fact remains that the employee will be utilizing the space later on that day. As an example, an observation of spaces at 10:30 AM on December 12, 1991 indicated that 14 of 29 vacant spaces were assigned to employees working the night and/or evening shifts. According to the Institute's records, 36 employees work during these two shifts, which would account for the vacant spaces.

8.2 Availability of Off-Street Parking Facilities in Immediate Area

Available commercial parking in the study area is addressed in depth in Section IV-2.2.1. As discussed, in that section, capacity of the six closest facilities are all at or above 90%. In fact, with an overall capacity rate of 86%, the area is nearing effective capacity, particularly when handicapped spaces and double parked cars are accounted for.

As regards to the comment about the Charles Street Jail site, the 100+ spaces proposed for the Charles Street Jail site are meant to replace 300+ spaces lost on Nashua Street as a result of the land swap with Suffolk County. These spaces are temporary and MGH is preparing a long-term plan for reuse of the jail site.

8.3 ITE Utilization Standards and Hawthorne Place Garage Occupancy by Shriners

Please see our response to Comment 8.1 above.

8.0

EXHIBIT A

Bruce Campbell & Associates
38 Chauncy Street, Suite 701
Boston MA 02111
TEL: (617) 542-1199 FAX: (617) 451-9904

MEMO

TO: Hawthorne Place Condominium Association **JOB NO:** 349-02

FROM: BC&A **FILE NO:** 349-dp2

DATE: December 4, 1991

SUBJECT: Parking Study - Hawthorne Place; Shriners Burns Institute, Boston, MA

INTRODUCTION

BC&A, retained by Widett, Slater and Goldman, was asked to study the utilization of the parking spaces reserved for the Shriners Burns Institute (SBI) located at the Hawthorne Place underground garage. A total of 114 spaces are utilized by SBI at the Hawthorne Place Garage, 104 of which the SBI own, and 10 are under a long-term lease agreement.

A parking survey was conducted and during the survey period, only 104 of the 114 SBI spaces were clearly marked and identified. Thus, our actual survey was of these 104 spaces and the results to follow were pro-rated for the total of 114. The survey periods were noted as follows:

Day	Date	Time Period
Friday	11/15/91	4:00-6:00 PM
Monday	11/18/91	8:00 AM - 6:00 PM
Tuesday	11/19/91	8:00 AM - 6:00 PM
Wednesday	11/20/91	8:00 AM - 6:00 PM
Thursday	11/21/91	6:00 PM - 4:00 AM
Friday	11/22/91	6:00 PM - 4:00 AM

Parking Survey Results

The data presented in Table 1 show the actual utilization of the SBI spaces at Hawthorne Place Garage. The percentage utilization (percent of parking spaces utilized) is also shown in Table 1. The average occupancy for these reserved SBI parking at Hawthorne Place Garage is also shown graphically in Figure 1 for a 24-hour period. Depicted in this figure is the reflection of shift changes; therefore, the daytime hours would show the higher utilization. From the data, the average occupancy for the 11:00 PM - 7:00 AM shift is 16%, for the 7:00 AM to 3:00 PM shift is 66% (34 reserve capacity) and for the 3:00 - 11:00 PM shift the utilization is 41%. Clearly, the 7:00 AM - 3:00 PM shift has higher utilization as expected.

8.1

CONCLUSION

In the immediate SBI area, there are approximately a dozen off-street public parking sites that have been identified by the Boston Transportation Department for current use. In addition to the public commercial parking facilities in the area, various private facilities and on-street spaces are available in close proximity of the SBI. With the advent of the additional 200± spaces proposed by Massachusetts General Hospital in redevelopment of the Charles Street Jail and current underutilization, there exists the potential that a surplus could be created in the area. **8.2**

Based on the Institute of Transportation Engineers standards, (85%-90% utilization) it is clear that the SBI spaces in the Hawthorne Place Garage are underutilized during the course of the 24-hour day. This is most evident during the peak utilization period (7:00 AM - 3:00 PM). A 66% occupancy rate for this shift leaves approximately 40 spaces unused during this peak time. Therefore, it is clear that under existing conditions, the Hawthorne Place Garage is underutilized. **8.3**

It is our opinion that the need for 150 new spaces for use by the Shriners has not been demonstrated, based on current usage, and that during off-peak hours there is sufficient capacity to accommodate the proposed SBI expansion without any increase in parking spaces.

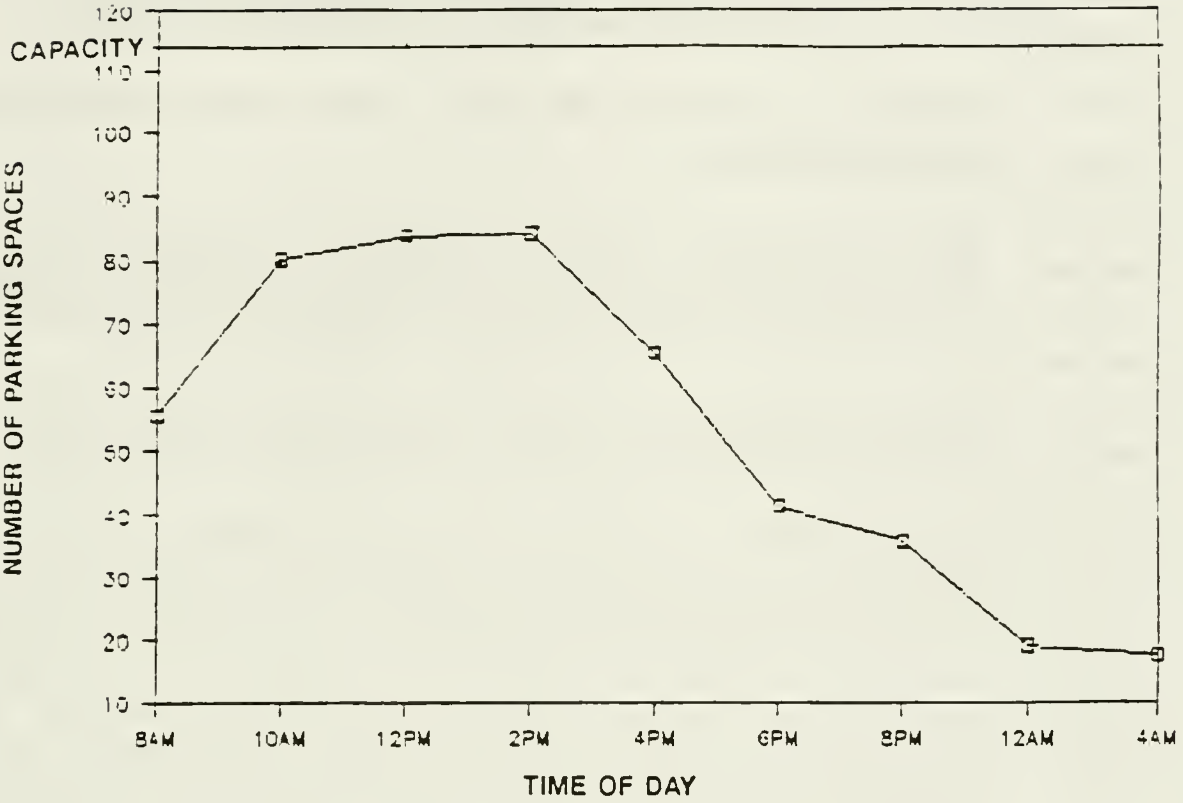
Table 1
S81 Parking Utilization
Hawthorne Place

Survey Time	11/15/91	11/18/91	11/19/91	11/20/91	11/21/91	11/22/91	AVG.	CAPACITY	AVG. % OCCUPIED
8AM		59	53	55			56	114	49 %
10AM		81	78	81			80	114	70 %
12PM		82	86	83			84	114	73 %
2PM		84	86	82			84	114	74 %
4PM	62	66	67	66			65	114	57 %
6PM	46	35	45	38			41	114	36 %
8PM					35	36	36	114	31 %
12AM					24	14	19	114	17 %
4AM					21	14	18	114	15 %

FIGURE 1

SBI PARKING UTILIZATION (AVG.)

HAWTHORNE PLACE



9.0 WIDETT, SLATER & GOLDMAN (ON BEHALF OF BLACKSTONE COMPANY), DECEMBER 6, 1991

9.1 Impact of Construction on Utility Service, Debris Removal, and Other Operational Concerns

Shriners is required to submit a Construction Management Plan (CMP) to the Boston Transportation Department (BTD) prior to initiating construction. Please see Section V-9.0 for detailed discussion of construction impacts.

9.2 Impact of Overhead Construction on Changing Wind Tunnel Effects

Little difference from project impacts already discussed is expected with initial construction of the project's upper portion. Once the upper portion is completed and the lower portion removed, typical practice is to enclose the construction area with a fabric sheeting material. This fabric material contains small holes for ventilation and also mitigates construction impacts beyond the site. The openings of this sheeting material represent less than 50%, therefore, winds will be restricted from flowing unimpeded below the upper portion of the project, once demolition of the existing structure occurs. Further, because some wind will be able to flow through the construction area, winds around building corners will also be diffused.

9.3 Blossom Street as a Material Staging Area

The proponent does not intend to use half of Blossom Street for material storage. Rather, the closing of a portion of Blossom Street is being necessitated by the construction of the truss level in Plan I. As discussed with BTD, the construction management plan will identify steps to minimize impacts and the contractor will arrange to store materials on-site.

9.4 Construction Noise Impacts on Blackstone Apartments and Regina Cleri Home, the Residents of Which are Typically Home During Customary Construction Hours

While much of the construction will take place on the proposed overhead construction site, most of the major noise producing equipment will be located at the ground level for all phases of construction. Modeling results were presented on Table V-9.3 of the DEIR/DPIR for various phases of construction. The typical location of the noise source (ground level or 5th Floor) is indicated on the DEIR/DPIR table. Pile-driving, although not specifically modelled since it is not included in the City's noise regulations, was an expected noise presented in the DEIR/DPIR. Since the DEIR/DPIR, it has been determined that pile-driving will not be required since construction of a slurry wall has been identified as being feasible at this site. This will eliminate the noisiest construction activity previously expected for the project. All construction noise modeling was conducted for a distance of 50 feet from the operating equipment, the nearest regulatory measurement location. Construction noise levels will be lower at locations farther than 50 feet from the construction site. Persons at home during the typical construction hours will experience these temporary elevated noise levels.

9.5 Impact from Construction Vibration on Possible Foundation Damage to Blackstone Apartments

The foundation methodology has been changed to include a slurry wall as described in the revised construction impacts section (Section V-9.0). The use of a slurry wall minimizes vibration impact and impacts to the groundwater table and therefore minimizes impacts to adjacent foundations.

9.6 Verification of Depth of Groundwater and Other Subsurface Conditions through Soils Analysis

Test borings have been completed which have led to the decision to use a slurry wall type foundation for the Replacement Facility.

9.0

WIDETT, SLATER & GOLDMAN, P.C.
COUNSELLORS AT LAW
SIXTY STATE STREET
BOSTON MASSACHUSETTS 02109
TELEPHONE 6 7 227 7200
FAX 6 7 227 [illegible]
TELEX 32 826

RECEIVED
DEC 19
MEPA

December 6, 1991

William T. Gage
MEPA Unit
Executive Office of Environmental Affairs
20th Floor
100 Cambridge Street
Boston, Massachusetts 02134

Re: EOEA No. 8688 (Shriners Burns Institute)

Dear Mr. Gage:

On behalf of Blackstone Company, owner of the apartment building designed for occupancy by elderly tenants at 33 Blossom Street, we offer the following comments regarding the draft environmental impact report submitted by Shriners Burns Institute relative to its proposed new nine story facility.

1. The strategy of constructing and occupying a partially completed building above an existing structure to be demolished is extremely complex, particularly in a constricted site. A logistics plan should be required in order to address **9.1** the impact of the construction configuration upon utility service, debris removal (including the location of dumpsters) and other operational concerns. In particular, the proponent should take into account the consequences of new wind patterns **9.2** which will be created by the unusual and changing tunnel effect of overhead construction.

2. The proponent proposes to use half of Blossom Street as a material staging area. Blossom Street is the sole means of access to Blackstone Apartments, whose main entrance would be immediately adjacent to the staging area. This will cause traffic congestion and impede access to the apartment **9.3** building.

3. Blackstone Apartments, together with the Regina Cleri Home (housing for elderly priests) and the Shriners building, form a courtyard which will amplify noise reflected **9.4** downward from the proposed overhead construction site. The noise control study exempts impact equipment such as pile drivers and pneumatic hammers. Because extensive demolition and piling are proposed, a high level of disturbance will result. It should be noted in this connection that the elderly residents of Blackstone Apartments and the Regina Cleri Home are typically home during customary construction hours (7:30-3:30). Additional noise analyses should be performed.

4. Similarly, the close proximity of the project to Blackstone Apartments and the likelihood of construction vibration justifies a review of possible foundation damage. **9.5** The soil characteristics of the Blackstone site would be relevant in this regard.

5. The draft report suggests that borings have not yet been done. Absent a soils analysis, the proponent's assumptions concerning the depth of groundwater and other subsurface conditions need to be verified. **9.6**

Please let me know if you require any additional information.

Sincerely yours,

Philip S. Lapatin

PSL:hr

10.0 ST. JOSEPH'S CHURCH, DECEMBER 12, 1991

10.1 Shadow Impacts on Church's Garden or Patio

See our response to Comment No. 7.6.

10.2 Shadow Impact on Sidewalk Between St. Joseph's Church and Regina Cleri Home

The shadow figures for the Winter Solstice and Vernal Equinox show the walkway between the St. Joseph's Church and Regina Cleri House, and the parking area are already shaded by existing buildings. During the winter when sun angles are low, existing buildings already shade areas immediately around the project site, while new shadows primarily occur away from the Replacement Facility. SHCC has also made arrangements to assist the Archdiocese with snow and ice removal.

10.3 Under-Utilization of Hawthorne Place Parking Spaces Owned by Shriners

Please see response to Rappaport and Rakov Comment No. 5.2.

10.4 Service Area and Unloading Dock

Please see response to Rappaport and Rakov Comment No. 5.6. Also, secondary access to the Regina Cleri parking area is available through a gate at its southeast corner, on O'Connell Way.

10.5 Construction-Related Impacts

Access including fire access to the abutting properties will be outlined in the construction management plan.

10.6 Construction Worker Parking and Use of MBTA

As noted in the DEIR/DPIR, parking for construction workers will not be provided on the site. The Shriners Burns Institute will attempt to locate satellite parking facilities for construction workers outside of the study area. These facilities will either be adjacent to transit to allow its use, or the Contractor will provide a shuttle service.

St. Joseph's Church
68 Cardinal O'Connell Way
West End, Boston, Mass. 02114

10.0

Dec. 5/91

RECEIVED
DEC 1 1991
MEPA

Hon. Susan F.Tierney,
Executive Office of Environmental Affairs
100 Cambridge St.
Boston, Mass.

Dear Secretary Tierney,

The report which was put together for theShriners Burns Institute, Titled :Proposed Draft Environmental Report" came into my hand about one week and a half ago. At that time I was involved in parish matters up to my elbows, so I could not respond to it immediately. I am now making a quick response. I wish this report was provided to me much earlier, as I have discovered that it was supplied to otherx more than a month ago.

As a general response I would like to say that it illustrates the truth that there is a big difference between appearance and reality. One would think by its size and pagination that issues were responded to in a reasonable fashion. The truth is, that it is a PR report, apparently offering solutions which are not solutions at all.

I would like first of all to speak to two particular areas of the substnce of the report and then to comment on the procedures envisioned during time of construction.

First of all as regards height: It apparently scales down the project, but in reality makes little difference in the shadowing effect to which I objected. In a previous letter I made out a statement tht on May 17th I with several friends measured the impact of shadowing on that date. I found that there would be no sun in our Patio and garden at 4 p.m. On Sept 2nd. I again made a test of shadowing in view of the scaled down decision which the Shriners Burns Institute had arrived at to build to 137 feet, as reported to me by Fr.Brian Conlon who attended a meeting while was away on vacation. On SEpt 2nd I again went out to the Patio with some friends. Again it was about 3:30 p.m. When we looked at the Sun going down over the Shriner's Building I said imagine what would happen if the new building were in place and it was rasied up to 137 feet. There would be absolutely no sun in the garden or in the Patio. This wold have a serious effect on the garden which now makes the area so attractive now environmentally. **10.1**

But there is a second consequence. There is a public pathway running back of our Rectory and close to Regina Cleri. Now this can be a treacherous area to negotiate in the heart of icy winter. But with the added height and no sun at all it will be totally dangerous. All the elderly priests, who come from their cars to Regina Cleri have to travel this path. This will be an invitation to disaster. In addition the parking area itself will also be effected by the same situation and will be turned into an ice rink. **10.2**

There is a second area in the substance of the proposal which should be dealt with. It is the question of the parking garage. It is clear now, from studies undertaken that the number of parking spaces owned and rented by Shriner Burns Hospital were markedly underused. A study has been prepared on this which has been made known to your office. This means that there is no justification for a garage for 150 cars. On the size lot this is preposterous. If this were markedly reduced to 100 cars it would certainly scale down the building. And if it were reduced to 50 cars along with the parking which they already have, it would reduce it much further. A garage of this proportions is totally unacceptable, in view of the parking available **10.3**

(2)
surrounding the hospital.

But what is more unforgiveable, with this plan for a garage they are still going to retain their unloading dock in the rear of the building as they have it now. This is a first class nuisance. 10.4

Let me illustrate what we have to face presently. On Wed. Dec. 4th at 11:30 a.m. a flat bed truck parked in the middle of the entrance into the Regina Parking lot It carried some mechanicals which were to be hoisted unto the roof of Shriner Burns Hospital. One and a half hours later the truck moved. In all that time access to cars parked in Reginal Cleri parking lot and access for deliveries was cut off entirely. Even an ambulance could not get in there then. What will happen when gantries are swinging steel beam trusses in the air putting them into place.

Now let me deal with the process which will be involved if this Environmental Certification is accepted. On page V-9.9 of the study we have a list of all the instruments to be used in the construction phase..this includes crains, trucks, back hoes etc. This is an enormous assembly of materials for such a project, but I can see that it is justified. What worries me is that a whole road is going to be cut off with minimal access for fire trucks.And this for three years or more. 10.5
In addition when this machinery is in operation and we have a funeral at our Church how is access to be provided. I have already detailed how three trucks tied up access to the parking lot for two hours on Dec. 4th. Card. O'Connell way is a very narrow way and Blossom street when it is narrowed down to one way again is excveptionally narrow. There is no way in which the interest of small abutters will be protected.

Then you have to take into he account the opeation of augers and the trucks moving in and out with disposal of sold fill and back hoes opeating. Those who sit in the office of the Environmental department, should come down and look at this location before they make any final decision.

When the problem of the Central Artery depression came up the problem of the bridge over the Charles to Charlestown was reviewed again the again. It was not accepted until at least seven reviews were undertaken. We cry out to you as a Board, set up to protect the small abutter to do your job without fear or favor. Make sure that those who are prepared to build this addition to the Shriners Burns Hospital be forced to think of alternatives.

There is one final point which I would like to develope. On page V-9.21 it is stated:"Constructions workers will be encouraged to u tilize the M.B.T.A. 10.6
It is estimated that there will be 200 workers on the job. I challenge you to go down to the job that is going on prfesently behind the North Station in the Building of the M.B.T.A garage. Just look at the way the cars are lined up and crowded in in every conceivable space. And they are within 50 yards of the NorthStation. This bears out my point that this whole Study is a PR job, it is entirely superficial. They are not going to get one Worker to use the M.B.T.A in that work and we will be deluged with cars. Your office cannot be so far removed from reality that they are not aware of this.

There is a clear conslusion from all of this. Hold up the certification of this project until those who are planning it, are forced to face alternatives which do not do a gross injustice to small and weak ab utters like St. Joseph's Church.

The test whether Offices set up by the state are really going to function to see tht justice is done to those who have no money and less clout will be exemplified on what is done with this appeal. St. Joseph's Church has been here since 1823. We welcome the Shriners Burns Hospital. It does matchless work. But this expansion will not mean that single more patient will be dealt with or have to be refused. It does not men that any one who works there now cannot find parking space in the absence of this new 150 lot garage.

Reasonable additions could be put on without working serious injustice on any neighbors. And the Environmental Protection Agency should make certain that it will make take this direction before a certificate of approval is issued.

Sincerely,

REv. Gerald L.Bucke Pastor
St. Joseph's Church.

Fr. Gerry Bucke

CC. Stephen Coyle, B.R.A Director.

Appendix A

Correspondence
MEPA Certificates

The Massachusetts General Hospital
Boston 02114

ST M. HADDAD
SECRETARY
NERAL COUNSEL

TELEPHONE: (617) 726-2220
TELECOPIER: (617) 726-8525

VIA FACSIMILE

January 23, 1992

Salvatore P. Russo, Ph.D.
Administrator
Shriners Hospitals for Crippled Children
51 Blossom Street
Boston, MA 02114

Dear Dr. Russo:

I am responding to your letter of January 22 inquiring whether the MGH might have approximately 80,000 square feet of medical and research space available for use by the Shriners Hospitals for Crippled Children for approximately three years starting in the spring of 1992.

Unfortunately, all of our main campus space is fully committed. Indeed, we are currently struggling to find approximately 18,000 square feet of space within the vicinity of our main campus to house programs currently located at 15 River Street which we will have to vacate by August 31, 1992.

We wish you well in your construction program and regret that we are unable to provide you with the temporary help that you have requested.

Sincerely,

Ernest M. Haddad

EMH/pje

GENERAL HOSPITAL CORPORATION
McLEAN HOSPITAL CORPORATION
SPAULDING REHABILITATION HOSPITAL CORPORATION

THE MGH INSTITUTE OF HEALTH PROFESSIONS, INC.
THE MGH PROFESSIONAL SERVICES CORPORATION
THE MGH HEALTH SERVICES CORPORATION

City of Boston
The Environment Department

Raymond L. Flynn
Mayor

Lorraine M. Downey
Director

Boston City Hall/Room 805
Boston, Massachusetts 02201
617/725-4416 or 725-3850

November 18, 1991

Mr. Mitchell L. Fischman
Director of Planning
HMM Associates, Inc.
196 Baker Avenue
Concord, MA 01742

RE: Shriners Burn Institute

Dear Mr. Fischman:

Thank you for your letter of October 31 describing the proposed construction of the Shriners Burns Institute Replacement Facility in Boston's West End. The background historical information that you provided has been very helpful in reviewing this project.

The proposed project appears to have little impact on significant archaeological resources for at least two reasons: 1) at least 80 % of the site has already been impacted by the construction of the existing facility, and 2) we have no documentation for the potential presence of any significant sites in this location. While the site was located on the Shawmut peninsula, the specific site was not settled until the nineteenth century. As you correctly indicate, the Wells School and adjacent apartment buildings were on the site most recently.

I would appreciate being notified immediately prior to project construction and given access to the site to record anything of geological or archaeological interest during the excavation phase of construction. This should in no way interfere with construction, but would allow us to verify the accuracy of our background research.

Sincerely,

Steven R. Pendery, Ph.D.
City Archaeologist

enc.
cc: B. Simon, MHC

Air Pollution Control, Boston Art, Back Bay Architectural, Beacon Hill Architectural, Boston Landmarks and the Conservation Commissions

The Commonwealth of Massachusetts
Executive Office of Environmental Affairs
100 Cambridge Street, Boston, 02202

WILLIAM F. WELD
GOVERNOR

ARGEO PAUL CELLUCCI
LIEUTENANT GOVERNOR

SUSAN F. TIERNEY
SECRETARY

(617) 727-9800

December 12, 1991

CERTIFICATE OF THE SECRETARY OF ENVIRONMENTAL AFFAIRS ON THE DRAFT ENVIRONMENTAL IMPACT REPORT

PROJECT NAME : The Shriners Burns Institute Replacement Facility
PROJECT LOCATION : 51 Blossom Street - Boston
EOEA NUMBER : 8688
PROJECT PROPONENT : The Shriners' Hospital
DATE NOTICED IN MONITOR : November 5, 1991

The Secretary of Environmental Affairs herein issues a statement that the Draft Environmental Impact Report (DEIR) submitted on the above project adequately and properly complies with the Massachusetts Environmental Policy Act (G. L., c. 30, s. 61-62H) and with its implementing regulations (301 CMR 11.00).

The proposed project consists of the demolition of 80,000 square feet (sf) of existing hospital space and its replacement with a 200,000 sf building with an additional 70,000 sf of below-grade parking (2.5 stories) for 150 cars. It will provide additional medical research space, increased patient bed space (although the number of beds will remain at 30), and expanded outpatient care space to permit an increase in daily capacity of patients from 30 to 75. Hospital staffing and research levels will increase by 62 positions to the proposed range of 332 employees. This project is proposed in two construction phases:

> Phase 1 includes the construction of steel trusses over the existing building which will support the construction of four levels above the existing building.
>
> Phase 2 includes the demolition of the existing building and construction of four levels of hospital functions and below grade parking.

The preferred alternative, as proposed, will be a 9-story building at 137 feet with 2.5 levels of below grade parking. Since the Environmental Notification Form (ENF), not only has the building height been reduced from 155 feet but the building footprint has also been reduced from 30,000 sf to 22,218 sf. The parking entrance/exit has been relocated to Blossom Street. The project has also created wider setbacks between the proposed building and the street.

The DEIR has adequately addressed the wind impacts outlined in my Certificate of June 21, 1991 for the Preferred Alternative. However, the shadow impacts on vegetation, particularly at Hawthorne Place and along the western wall vegetation of St. Joseph's Rectory during the Vernal Equinox have not been sufficiently addressed and must be addressed in the Final Environmental Impact Report (FEIR). The reduction in shadow during the Vernal Equinox because of the new massing configuration in the landscaped area between St. Joseph's and the Regina Cleri Building is commendable.

I have serious reservations concerning the parking demand and supply assumptions in the DEIR. The DEIR does not convince me that an additional 150 parking spaces are required for this project. To reduce the number of parking spaces which are leased off-site, so that these spaces can be accommodated on-site, only increases the number of available parking spaces in the area. Providing parking for such categories of users as the Board of Directors (40 percent on a daily basis), auditorium users, and volunteers does not appear warranted from an environmental perspective, particularly given the proximity of public transit. If the proponent maintains its existing off-site parking arrangements (124 spaces), it appears that the hospital will really only require about 60 spaces in its on-site parking garage to accommodate the inpatients and additional outpatients that are expected.

The project proponent must develop a comprehensive parking management plan to utilize the parking spaces it presently has more efficiently, in order that the spaces are not just reserved for one employee for a 24-hour period. By utilizing the hospital's existing daily auto usage rates, the DEIR has not developed more acceptable parking mitigation efforts. With an improved mode share split for transit from hospital and research workers, the project does not warrant a 150 space garage.

The FEIR must present a full mitigation package and specify the amount of its proposed transit pass subsidy to be provided to its employees and construction workers. I urge the proponent to develop plans to maximize the use of its van to reduce patient parking demand. The Massachusetts Bay Transportation Authority bus route 350 no longer operates along Cambridge Street. Figure VI-1.15 should show the pedestrian route between St. Joseph's Church and Regina Cleri.

The FEIR should identify the source for the one percent traffic growth rate for each year. Are there no existing City of Boston or Massachusetts Department of Public Works annual weekday 24-hour traffic volumes available for roadways within the study area? I direct the proponent in the FEIR to work with the Boston Transportation Department (BTD) to develop mitigation measures for the Staniford Street/O'Connell Way intersection during the PM peak hour. Before the FEIR is completed, I also suggest that the proponent review its construction management plan and its proposed closure of the northbound side of Blossom Street with the BTD's Construction Management Division. How many months would the northbound side of Blossom Street be closed? It appears that more coordination with the Massachusetts General Hospital is required in this area in order to reduce construction impacts and traffic delays.

Finally, I encourage the proponent to make every effort in the FEIR to reduce the remaining building height from 137 feet. I believe that the proponent can reduce the building height further, particularly when parking is reduced and replaced with other hospital functions, and I encourage this effort.

The FEIR should address all comments on the DEIR. It must provide detailed information on mitigation. The proponent should meet with the Boston Redevelopment Authority and the BTD to ensure that mitigation will be adequately identified and addressed within the FEIR.

December 12, 1991
DATE

Susan F. Tierney, Secretary

Comments received : Boston Environment Dept., 11/22/91
MHC, 12/4/91
BRA, 12/5/91
BWSC, 12/5/91
Rappaport & Rakov, 12/5/91
Nancy Buehler, 12/5/91
Widett, Slater & Goldman, 12/5/91
Widett, Slater & Goldman, 12/6/91
Bruce Campbell & Assoc., 12/6/91
Widett, Slater & Goldman, 12/6/91
Choate, Hall & Stewart, 12/11/91
HMM Assoc., 12/12/91

SFT/WTG/wg

The Commonwealth of Massachusetts
Executive Office of Environmental Affairs
100 Cambridge Street, Boston, 02202

WILLIAM F. WELD
GOVERNOR

ARGEO PAUL CELLUCCI
LIEUTENANT GOVERNOR

SUSAN F. TIERNEY
SECRETARY

(617) 727-9800

April 3, 1992

CERTIFICATE OF THE SECRETARY OF ENVIRONMENTAL AFFAIRS ON THE FINAL ENVIRONMENTAL IMPACT REPORT

PROJECT NAME : The Shriners Burns Institute Replacement Facility
PROJECT LOCATION : 51 Blossom Street - Boston
EOEA NUMBER : 8688
PROJECT PROPONENT : The Shriners Hospital
DATE NOTICED IN MONITOR : February 26, 1992

The Secretary of Environmental Affairs herein issues a statement that the Final Environmental Impact Report (FEIR) submitted on the above project adequately and properly complies with the Massachusetts Environmental Policy Act (G. L., c. 30, s. 61-62H) and with its implementing regulations (301 CMR 11.00).

The FEIR describes the following project. The proposed nine story, 137-foot tall replacement facility involves 200,000 square feet (sf) with 2.5 levels of below-grade parking for 133 cars. The truss level (5) will house mechanical equipment. The replacement facility will provide about 30,000 sf of medical research space, 30 inpatient beds, and outpatient care space designed to accommodate 75 patients on a daily basis. Existing off-site parking will be reduced by 7 spaces in the Hawthorne Place Garage to 97 spaces. Hospital employment will increase by 62 to approximately 332 employees and researchers. The parking garage entrance/exit will be located on Blossom Street.

The project consists of two construction phases:

Phase I includes the construction of steel trusses over the existing 80,000 sf building which will support the construction of four levels above the existing building.

Phase II includes the demolition of the existing building and the construction of four levels of hospital functions and below-grade parking.

This project is also being reviewed by the Boston Redevelopment Authority (BRA) pursuant to the City's Article 31 process. The proponent filed a joint DEIR/DPIR, but has filed this FEIR while awaiting the BRA's determination on the DPIR. While I encourage the filing of joint documents where possible, the fact that the state and local review processes have diverged at this point does not preclude my evaluation of the FEIR, or its merits, to determine whether it has satisfied the requirements of my Certificate on the DEIR. It is my judgement that the FEIR does substantially comply with that Certificate.

Issues certainly remain and are the subject of ongoing discussions between the proponent and the BRA. However, I believe that the remaining environmental issues, as I have identified them below, will be resolved as the BRA process continues. I therefore request that the proponent provide me with an update, responding to the questions raised herein.

The FEIR has provided additional shadow impact analysis on vegetation, particularly at 2 Hawthorne Place and along St. Joseph Rectory's western wall, during the vernal equinox. The increase in shadow will be two to four hours per day in limited areas. Some additional shadow will also be created in the rectory patio during the late afternoon in the spring and fall seasons. The FEIR has identified the vegetation as primarily shade tolerant. It has concluded that no negative growth impacts are expected. I accept this analysis of shadow impacts.

I have encouraged the proponent to reduce the number of new parking spaces in the proposed garage and to retain the 114 spaces now located in the Hawthorne Place Garage. The proponent is continuing to work with the BRA and the Boston Transportation Department (BTD) to reduce parking in the proposed garage from the 133 spaces proposed in the FEIR. It is my clear understanding that the proponent will reduce the number of parking spaces to a total that is acceptable to the BRA and BTD, and my decision is based on that understanding. If parking issues are not resolved in this way, the proponent must submit a Notice of Project Change.

In addition to the reduction of parking, the FEIR's mitigation package includes: pedestrian safety improvements such as the construction of new crosswalks along O'Connell Way at the access point to existing pedestrian paths and across Blossom Street in front of the building, transit subsidies for employees and construction workers, five parking spaces in the proposed garage will be reserved for ridesharing, and the proponent's participation in the Massachusetts General Hospital (MGH) ridesharing program for its employees. The proponent should also consult with Caravan, the state ridesharing coordinator. The FEIR did not identify the amount of the transit subsidy that will be offered each employee and who will be eligible among hospital employees and researchers. Who provides the transit subsidy and what is the amount of the subsidy for construction workers at the site? The proponent must supply this information to the MEPA Unit.

I direct the proponent to address the issues raised in the BRA's comment letter and to resolve them before the Article 31 process is completed. The proponent should notify me of the resolution of these issues. If any further revisions occur to the proposed project, the proponent must submit a Notice of Project Change to the MEPA Unit, in accordance with 301 CMR 11.17.

April 3, 1992
Date

Susan F. Tierney
Susan F. Tierney, Secretary

Comments received : Widett, Slater & Goldman, 3/16/92
Boston Environment Dept., 3/16/92
Nutter, McClennen & Fish, 3/17/92
Widett, Slater & Goldman, 3/18/92
BWSC, 3/25/92
Rappaport & Rakov, 3/27/92
Widett, Slater & Goldman, 3/30/92
Edward Gelles, 3/31/92
HMM Associates, 4/1/92
BRA, 4/1/92
Choate, Hall & Stewart, 4/2/92
Choate, Hall & Stewart, 4/3/92

SFT/WTG/wg

Appendix B

Transportation Impact Analyses

Appendix B1

Manual Turning Movement Counts

te Code : 94900000
S Street: STANIFORD ST
W Street: CARDNIAL O'CONNELL WAY
ather : CLOUDY/DRIZZLE

Sum of the Cars and Truck/Bus

PAGE: 1
FILE: stnford
GCF : 1.03

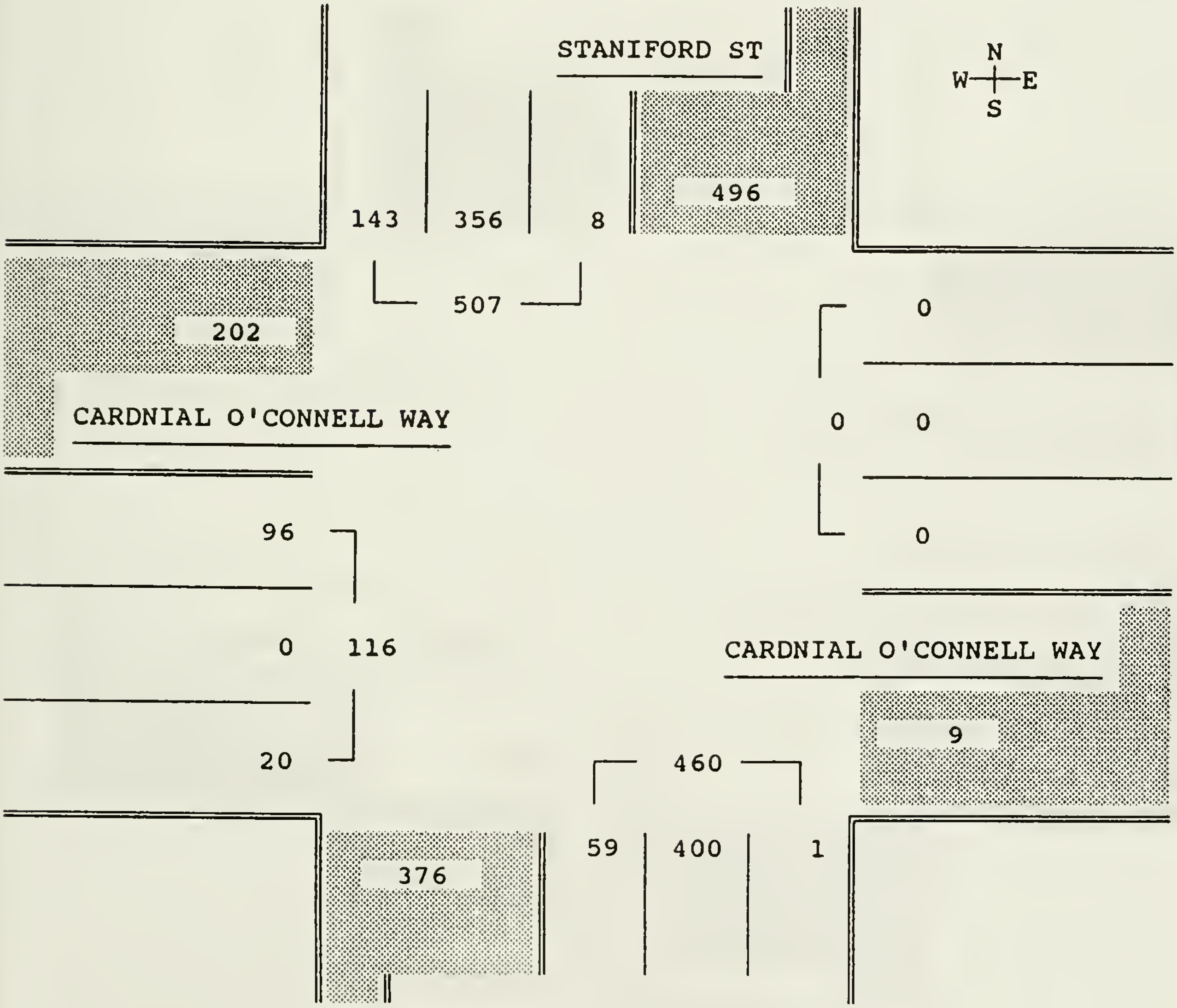
DATE: 5/14/91

PEAK PERIOD ANALYSIS FOR THE PERIOD: 7:00 AM - 9:00 AM

DIRECTION FROM	START PEAK HOUR	PEAK HR FACTOR	VOLUMES Right	Thru	Left	Total	PERCENTS Right	Thru	Left
North	8:00 AM	0.94	143	356	8	507	28	70	2
East	8:00 AM	0.00	0	0	0	0	0	0	0
South	8:00 AM	0.88	1	400	59	460	0	87	13
West	7:45 AM	0.82	20	0	105	125	16	0	84

Entire Intersection

DIRECTION FROM	START PEAK HOUR	PEAK HR FACTOR	VOLUMES Right	Thru	Left	Total	PERCENTS Right	Thru	Left
North	8:00 AM	0.94	143	356	8	507	28	70	2
East		0.00	0	0	0	0	0	0	0
South		0.88	1	400	59	460	0	87	13
West		0.85	20	0	96	116	17	0	83



Site Code : 94900000
N-S Street: STANIFORD ST
E-W Street: CARDNIAL O'CONNELL WAY
Weather : CLOUDY/DRIZZLE

Movements by: Cars

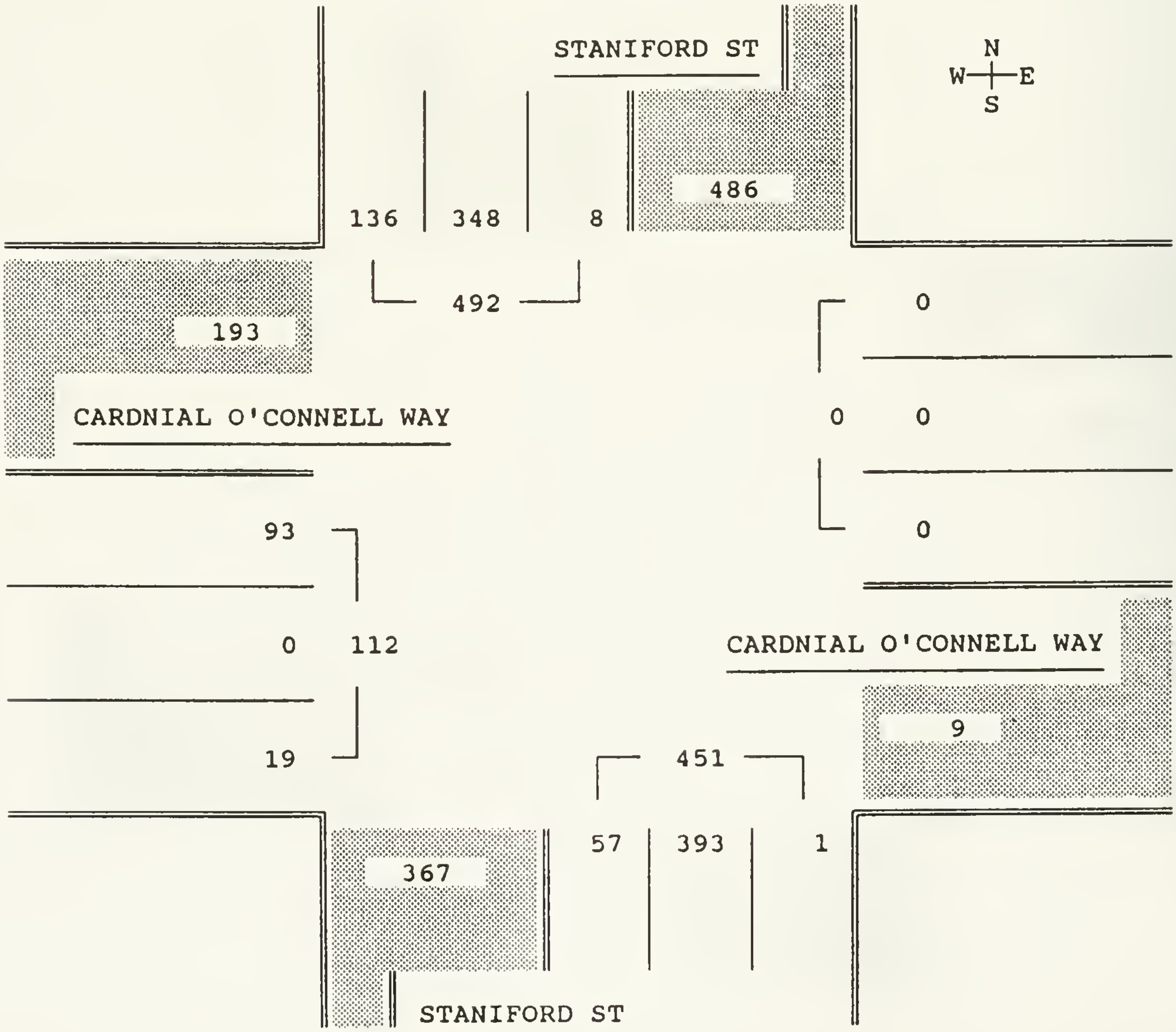
FILE: stnford
GCF : 1.03
DATE: 5/14/91

PEAK PERIOD ANALYSIS FOR THE PERIOD: 7:00 AM - 9:00 AM

DIRECTION FROM	START PEAK HOUR	PEAK HR FACTOR	VOLUMES Right	VOLUMES Thru	VOLUMES Left	VOLUMES Total	PERCENTS Right	PERCENTS Thru	PERCENTS Left
North	8:00 AM	0.94	136	348	8	492	28	71	2
East	8:00 AM	0.00	0	0	0	0	0	0	0
South	8:00 AM	0.87	1	393	57	451	0	87	13
West	7:45 AM	0.83	19	0	100	119	16	0	84

Entire Intersection

DIRECTION FROM	START PEAK HOUR	PEAK HR FACTOR	VOLUMES Right	VOLUMES Thru	VOLUMES Left	VOLUMES Total	PERCENTS Right	PERCENTS Thru	PERCENTS Left
North	8:00 AM	0.94	136	348	8	492	28	71	2
East		0.00	0	0	0	0	0	0	0
South		0.87	1	393	57	451	0	87	13
West		0.88	19	0	93	112	17	0	83



ite Code : 94900000
-S Street: STANIFORD ST
-W Street: CARDNIAL O'CONNELL WAY
eather : CLOUDY/DRIZZLE

Movements by: Truck/Bus

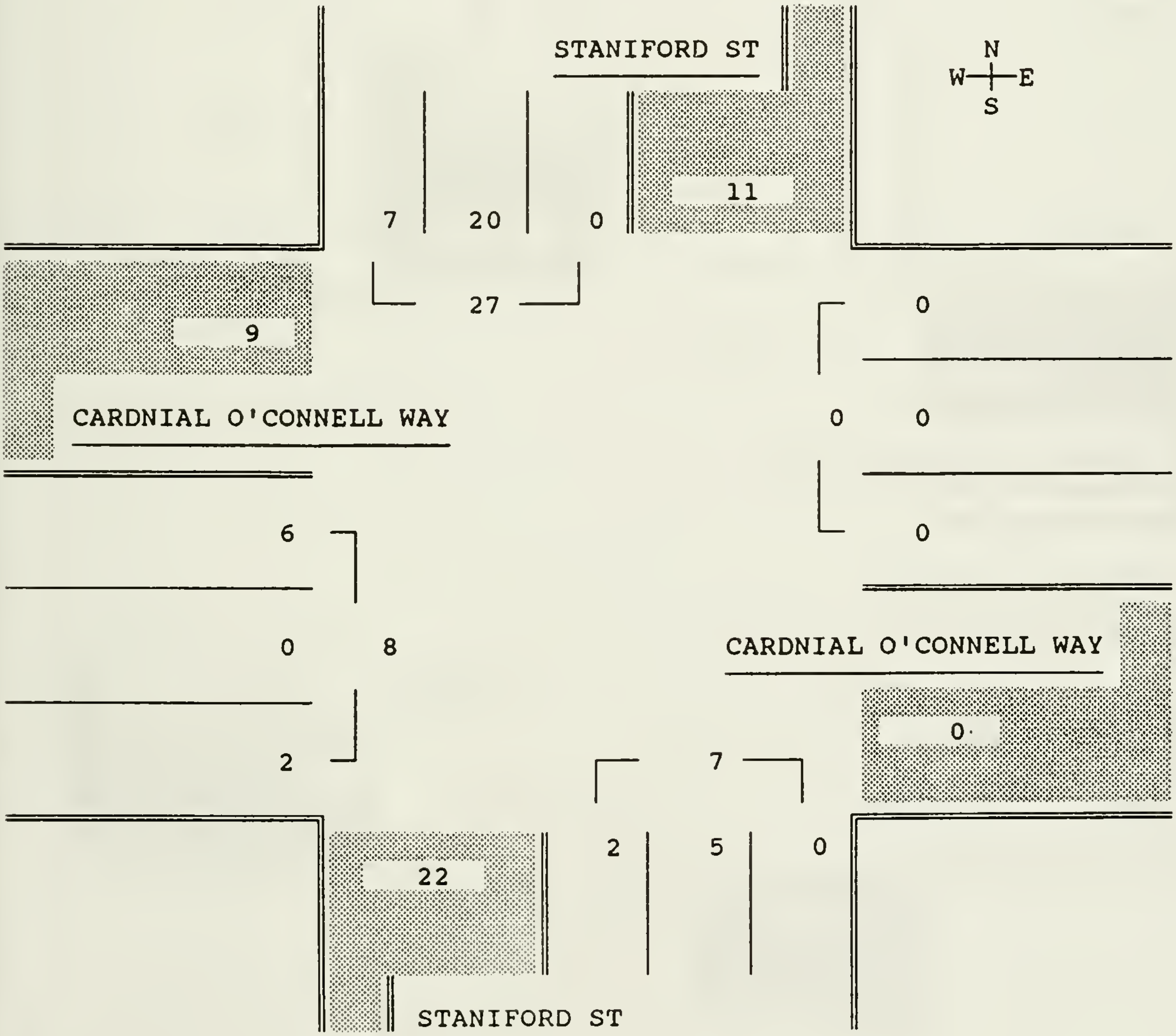
PAGE: 1
FILE: stnford
GCF : 1.03
DATE: 5/14/91

PEAK PERIOD ANALYSIS FOR THE PERIOD: 7:00 AM - 9:00 AM

DIRECTION FROM	START PEAK HOUR	PEAK HR FACTOR	.... VOLUMES				.... PERCENTS ...		
			Right	Thru	Left	Total	Right	Thru	Left
North	7:00 AM	0.75	7	20	0	27	26	74	0
East	7:00 AM	0.00	0	0	0	0	0	0	0
South	7:30 AM	0.67	0	7	1	8	0	88	12
West	7:00 AM	0.67	2	0	6	8	25	0	75

Entire Intersection

DIRECTION FROM	START PEAK HOUR	PEAK HR FACTOR	Right	Thru	Left	Total	Right	Thru	Left
North	7:00 AM	0.75	7	20	0	27	26	74	0
East		0.00	0	0	0	0	0	0	0
South		0.88	0	5	2	7	0	71	29
West		0.67	2	0	6	8	25	0	75



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Site Code : 94900000                                                                    PAGE:  1
N-S Street: STANIFORD ST                                                                FILE: stnford
E-W Street: CARDNIAL O'CONNELL WAY                                                      GCF : 1.03
Weather   : CLOUDY/DRIZZLE                  Sum of the Cars and Truck/Bus
                                                                                        DATE:  5/14/91
----------------------------------------------------------------------------------------------------

                    PEAK PERIOD ANALYSIS FOR THE PERIOD:  4:00 PM -  6:00 PM

         DIRECTION     START      PEAK HR        ........ VOLUMES ........        .... PERCENTS ...
           FROM      PEAK HOUR    FACTOR       Right  Thru  Left   Total       Right  Thru  Left
         ---------------------------------------------------------------------------------------
          North      4:00 PM       0.87          90   393     6     489          18    80     1
           East      4:00 PM       0.00           0     0     0       0           0     0     0
          South      4:45 PM       0.95           0   482    77     559           0    86    14
           West      4:45 PM       0.84          24     0   182     206          12     0    88

                                           Entire Intersection

          North      4:00 PM       0.87          90   393     6     489          18    80     1
           East                    0.00           0     0     0       0           0     0     0
          South                    0.89           0   492    63     555           0    89    11
           West                    0.83          12     1   184     197           6     1    93
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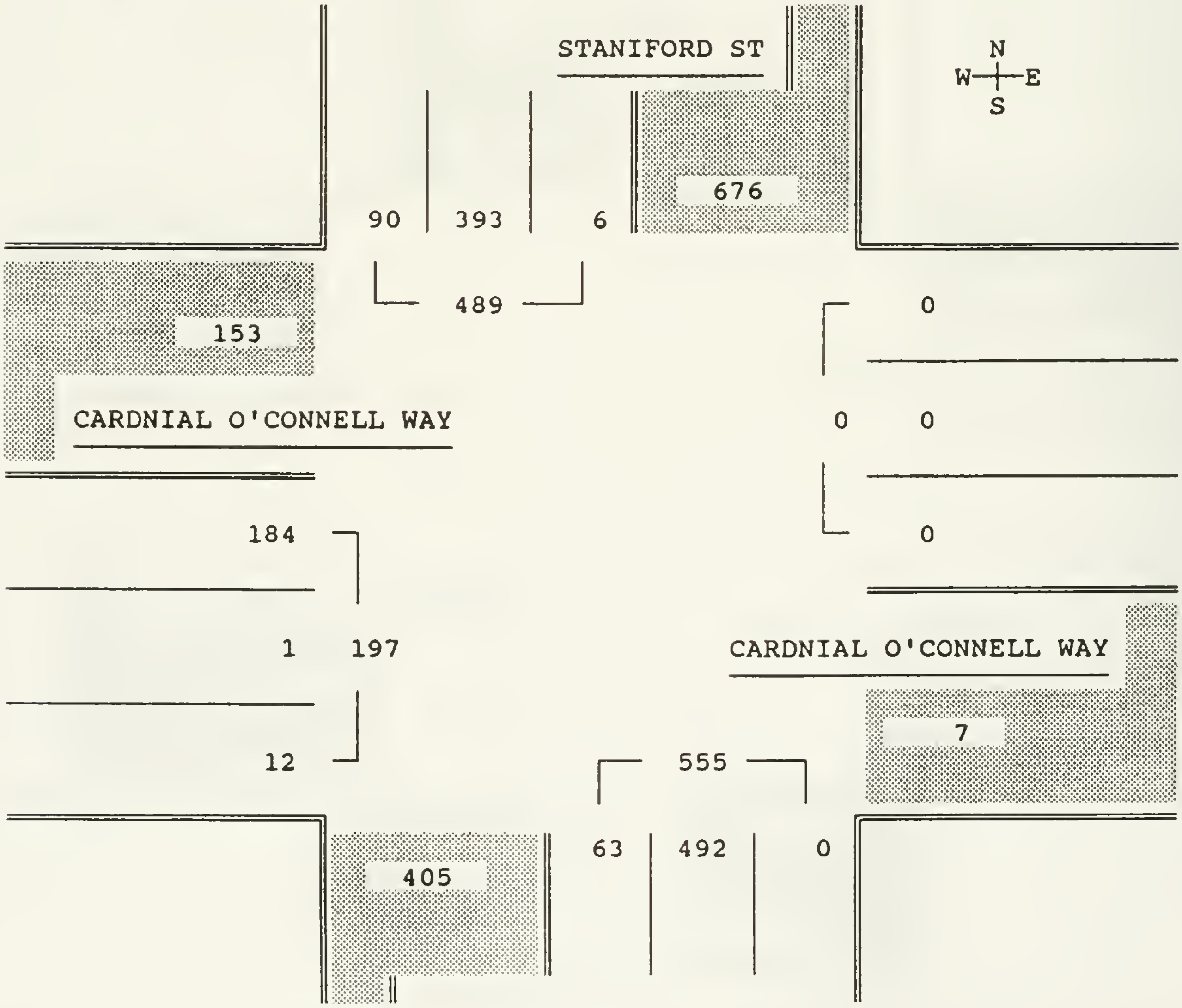


ite Code : 94900000
-S Street: STANIFORD ST
-W Street: CARDNIAL O'CONNELL WAY
eather : CLOUDY/DRIZZLE

Movements by: Cars

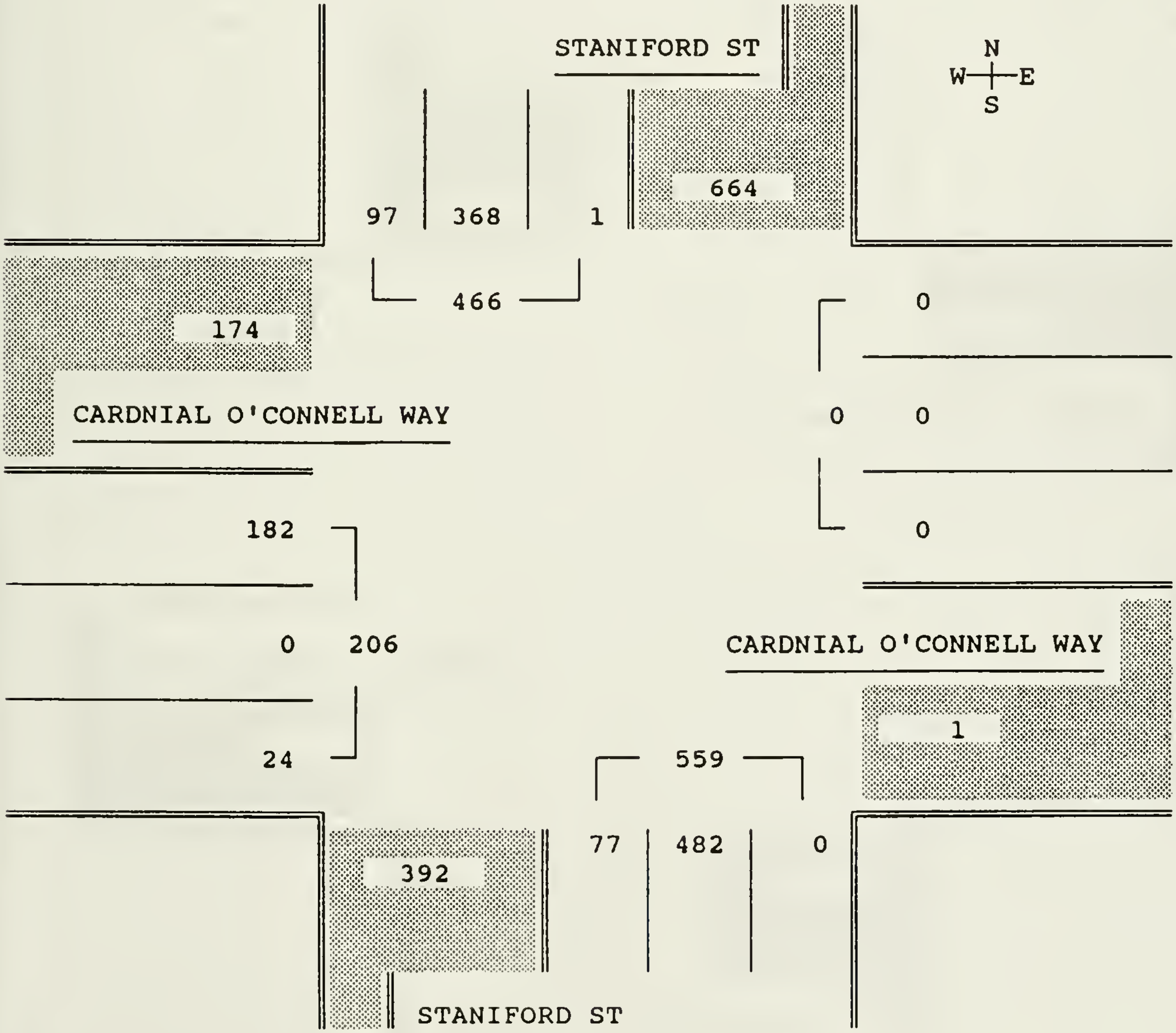
PAGE: 1
FILE: stnford
GCF : 1.03
DATE: 5/14/91

PEAK PERIOD ANALYSIS FOR THE PERIOD: 4:00 PM - 6:00 PM

DIRECTION FROM	START PEAK HOUR	PEAK HR FACTOR	.... VOLUMES .... Right	Thru	Left	Total	.... PERCENTS ... Right	Thru	Left
North	4:00 PM	0.88	90	386	6	482	19	80	1
East	4:00 PM	0.00	0	0	0	0	0	0	0
South	4:45 PM	0.95	0	482	77	559	0	86	14
West	4:45 PM	0.84	24	0	182	206	12	0	88

Entire Intersection

DIRECTION FROM	START PEAK HOUR	PEAK HR FACTOR	Right	Thru	Left	Total	Right	Thru	Left
North	4:45 PM	0.90	97	368	1	466	21	79	0
East		0.00	0	0	0	0	0	0	0
South		0.95	0	482	77	559	0	86	14
West		0.84	24	0	182	206	12	0	88



Site Code : 94900000
N-S Street: STANIFORD ST
E-W Street: CARDNIAL O'CONNELL WAY
Weather : CLOUDY/DRIZZLE

Movements by: Truck/Bus

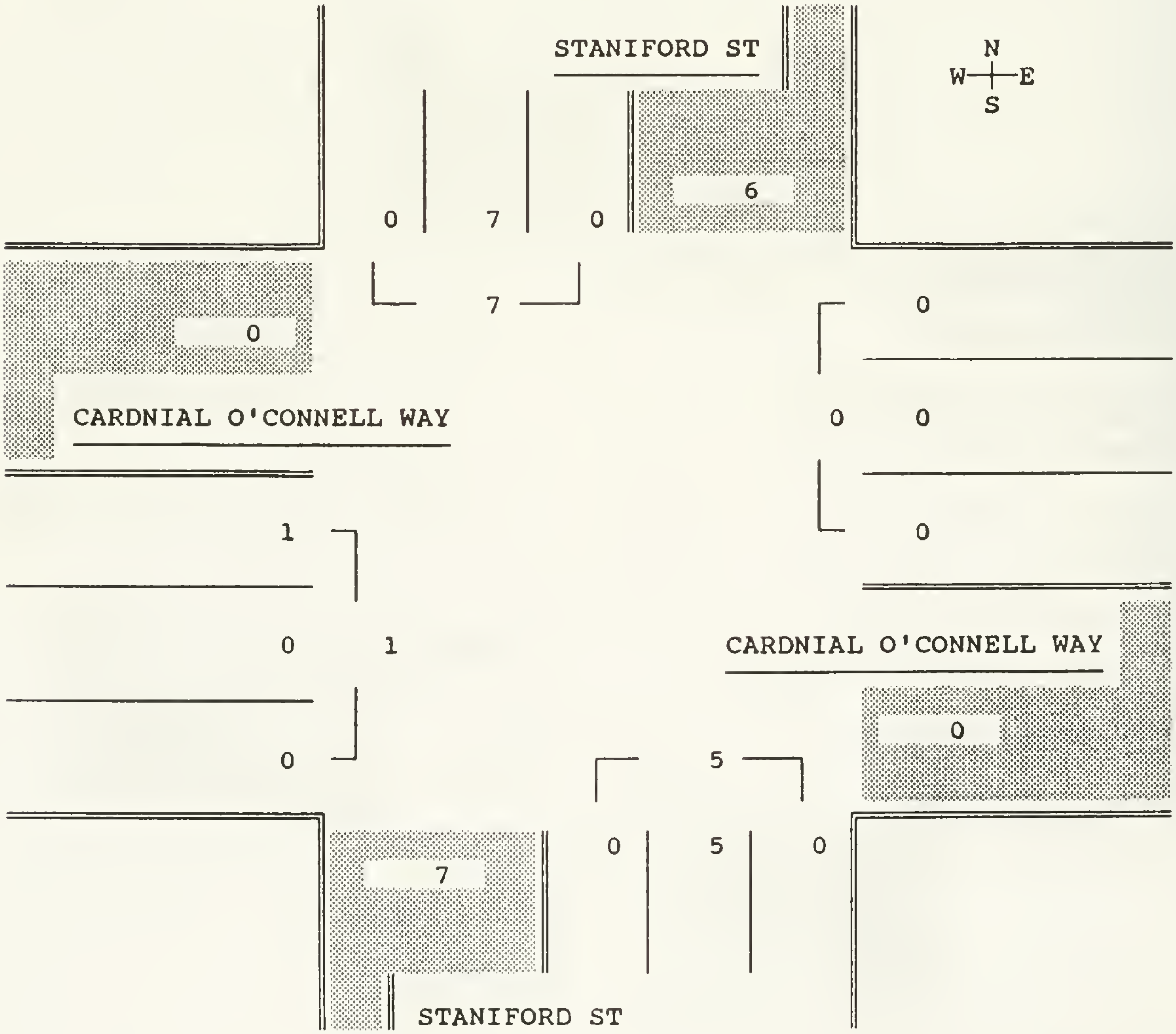
FILE: stnford
GCF : 1.03
DATE: 5/14/9

PEAK PERIOD ANALYSIS FOR THE PERIOD: 4:00 PM - 6:00 PM

DIRECTION FROM	START PEAK HOUR	PEAK HR FACTOR	VOLUMES Right	VOLUMES Thru	VOLUMES Left	VOLUMES Total	PERCENTS Right	PERCENTS Thru	PERCENTS Left
North	4:00 PM	0.58	0	7	0	7	0	%100	0
East	4:00 PM	0.00	0	0	0	0	0	0	0
South	4:00 PM	0.31	0	5	0	5	0	%100	0
West	4:00 PM	0.25	0	0	1	1	0	0	%100

Entire Intersection

DIRECTION FROM	START PEAK HOUR	PEAK HR FACTOR	VOLUMES Right	VOLUMES Thru	VOLUMES Left	VOLUMES Total	PERCENTS Right	PERCENTS Thru	PERCENTS Left
North	4:00 PM	0.58	0	7	0	7	0	%100	0
East		0.00	0	0	0	0	0	0	0
South		0.31	0	5	0	5	0	%100	0
West		0.25	0	0	1	1	0	0	%100



ite Code : 94900000
-S Street: STANIFORD ST
-W Street: CARDNIAL O'CONNELL WAY
eather : CLOUDY/DRIZZLE

Sum of the Cars and Truck/Bus

PAGE: 1
FILE: stnford
GCF : 1.03

DATE: 5/14/91

ime	From North			From East			From South			From West			Vehicle
egin	RT	THRU	LT	RT	THRU	LT	RT	THRU	LT	RT	THRU	LT	Total
6:30	19	58	1	0	0	0	0	27	8	1	0	5	119
6:45	38	67	1	0	0	0	0	42	7	0	0	8	163
R TOTAL	57	125	2	0	0	0	0	69	15	1	0	13	282
7:00 AM	42	69	1	0	0	0	0	59	10	2	0	13	196
7:15	36	65	1	0	0	0	0	71	7	7	0	18	205
7:30	34	63	0	0	0	0	0	71	6	0	0	22	196
7:45	30	77	0	0	0	0	0	91	12	4	0	34	248
R TOTAL	142	274	2	0	0	0	0	292	35	13	0	87	845
8:00 AM	35	97	3	0	0	0	1	101	16	7	0	27	287
8:15	29	77	2	0	0	0	0	96	14	3	0	23	244
8:30	36	97	1	0	0	0	0	87	14	6	0	21	262
8:45	43	85	2	0	0	0	0	116	15	4	0	25	290
R TOTAL	143	356	8	0	0	0	1	400	59	20	0	96	1083
Break													
4:00 PM	27	111	2	0	0	0	0	138	18	2	0	57	355
4:15	22	92	3	0	0	0	0	121	14	5	0	40	297
4:30	23	85	0	0	0	0	0	122	10	4	1	48	293
4:45	18	105	1	0	0	0	0	111	21	1	0	39	296
R TOTAL	90	393	6	0	0	0	0	492	63	12	1	184	1241
5:00 PM	18	92	0	0	0	0	0	129	18	5	0	56	318
5:15	32	97	0	0	0	0	0	118	20	8	0	39	314
5:30	29	79	0	0	0	0	0	124	18	10	0	48	308
5:45	24	66	2	0	0	0	0	107	16	4	0	32	251
R TOTAL	103	334	2	0	0	0	0	478	72	27	0	175	1191
AY TOTAL	535	1482	20	0	0	0	1	1731	244	73	1	555	4642

Site Code : 94900000
N-S Street: STANIFORD ST
E-W Street: CARDNIAL O'CONNELL WAY
Weather : CLOUDY/DRIZZLE

PAGE: 1
FILE: stnford
GCF : 1.03

Sum of the Cars and Truck/Bus

DATE: 5/14/9

Time	From North			From East			From South			From West			Vehicle
Begin	RT	THRU	LT	RT	THRU	LT	RT	THRU	LT	RT	THRU	LT	Total
6:00	57	125	2	0	0	0	0	69	15	1	0	13	282
7:00	142	274	2	0	0	0	0	292	35	13	0	87	845
8:00	143	356	8	0	0	0	1	400	59	20	0	96	1083
Break													
4:00	90	393	6	0	0	0	0	492	63	12	1	184	1241
5:00	103	334	2	0	0	0	0	478	72	27	0	175	1191
DAY TOTAL	535	1482	20	0	0	0	1	1731	244	73	1	555	4642

ite Code : 94900000
-S Street: STANIFORD ST
:-W Street: CARDNIAL O'CONNELL WAY
eather : CLOUDY/DRIZZLE

Movements by: Cars

PAGE: 1
FILE: stnford
GCF : 1.03
DATE: 5/14/91

ime	From North			From East			From South			From West			Vehicle
egin	RT	THRU	LT	RT	THRU	LT	RT	THRU	LT	RT	THRU	LT	Total
6:30	18	51	1	0	0	0	0	27	8	1	0	4	110
6:45	38	62	1	0	0	0	0	41	5	0	0	7	154
R TOTAL	56	113	2	0	0	0	0	68	13	1	0	11	264
7:00 AM	42	65	1	0	0	0	0	59	8	2	0	11	188
7:15	34	59	1	0	0	0	0	69	7	5	0	16	191
7:30	32	59	0	0	0	0	0	69	6	0	0	21	187
7:45	27	71	0	0	0	0	0	90	12	4	0	32	236
R TOTAL	135	254	2	0	0	0	0	287	33	11	0	80	802
8:00 AM	34	94	3	0	0	0	1	100	15	7	0	25	279
8:15	28	75	2	0	0	0	0	93	14	2	0	22	236
8:30	32	95	1	0	0	0	0	85	13	6	0	21	253
8:45	42	84	2	0	0	0	0	115	15	4	0	25	287
R TOTAL	136	348	8	0	0	0	1	393	57	19	0	93	1055
Break													
4:00 PM	27	108	2	0	0	0	0	137	18	2	0	57	351
4:15	22	91	3	0	0	0	0	121	14	5	0	39	295
4:30	23	84	0	0	0	0	0	117	10	4	1	48	287
4:45	18	103	1	0	0	0	0	111	21	1	0	39	294
R TOTAL	90	386	6	0	0	0	0	486	63	12	1	183	1227
5:00 PM	18	90	0	0	0	0	0	129	18	5	0	56	316
5:15	32	97	0	0	0	0	0	118	20	8	0	39	314
5:30	29	78	0	0	0	0	0	124	18	10	0	48	307
5:45	24	66	2	0	0	0	0	106	16	4	0	31	249
R TOTAL	103	331	2	0	0	0	0	477	72	27	0	174	1186
AY TOTAL	520	1432	20	0	0	0	1	1711	238	70	1	541	4534

Site Code : 94900000
N-S Street: STANIFORD ST
E-W Street: CARDNIAL O'CONNELL WAY
Weather : CLOUDY/DRIZZLE

Movements by: Cars

PAGE: 1
FILE: stnford
GCF : 1.03
DATE: 5/14/91

Time	From North			From East			From South			From West			Vehicle
Begin	RT	THRU	LT	RT	THRU	LT	RT	THRU	LT	RT	THRU	LT	Total
6:00	56	113	2	0	0	0	0	68	13	1	0	11	264
7:00	135	254	2	0	0	0	0	287	33	11	0	80	802
8:00	136	348	8	0	0	0	1	393	57	19	0	93	1055
Break													
4:00	90	386	6	0	0	0	0	486	63	12	1	183	1227
5:00	103	331	2	0	0	0	0	477	72	27	0	174	1186
DAY TOTAL	520	1432	20	0	0	0	1	1711	238	70	1	541	4534

ite Code : 94900000
-S Street: STANIFORD ST
-W Street: CARDNIAL O'CONNELL WAY
eather : CLOUDY/DRIZZLE

Movements by: Truck/Bus

PAGE: 1
FILE: stnford
GCF : 1.03
DATE: 5/14/91

ime	From North			From East			From South			From West			Vehicle
egin	RT	THRU	LT	RT	THRU	LT	RT	THRU	LT	RT	THRU	LT	Total
6:30	1	6	0	0	0	0	0	0	0	0	0	1	8
6:45	0	5	0	0	0	0	0	1	2	0	0	1	9
R TOTAL	1	11	0	0	0	0	0	1	2	0	0	2	17
7:00 AM	0	4	0	0	0	0	0	0	2	0	0	2	8
7:15	2	6	0	0	0	0	0	2	0	2	0	1	13
7:30	2	4	0	0	0	0	0	2	0	0	0	1	9
7:45	3	6	0	0	0	0	0	1	0	0	0	2	12
R TOTAL	7	20	0	0	0	0	0	5	2	2	0	6	42
8:00 AM	1	3	0	0	0	0	0	1	1	0	0	2	8
8:15	1	2	0	0	0	0	0	3	0	1	0	1	8
8:30	4	2	0	0	0	0	0	1	1	0	0	0	8
8:45	1	1	0	0	0	0	0	1	0	0	0	0	3
R TOTAL	7	8	0	0	0	0	0	6	2	1	0	3	27
Break													
4:00 PM	0	3	0	0	0	0	0	1	0	0	0	0	4
4:15	0	1	0	0	0	0	0	0	0	0	0	1	2
4:30	0	1	0	0	0	0	0	4	0	0	0	0	5
4:45	0	2	0	0	0	0	0	0	0	0	0	0	2
R TOTAL	0	7	0	0	0	0	0	5	0	0	0	1	13
5:00 PM	0	2	0	0	0	0	0	0	0	0	0	0	2
Break													
5:30	0	1	0	0	0	0	0	0	0	0	0	0	1
5:45	0	0	0	0	0	0	0	1	0	0	0	1	2
R TOTAL	0	3	0	0	0	0	0	1	0	0	0	1	5
AY TOTAL	15	49	0	0	0	0	0	18	6	3	0	13	104

Site Code : 94900000
N-S Street: STANIFORD ST
E-W Street: CARDNIAL O'CONNELL WAY
Weather : CLOUDY/DRIZZLE

Movements by: Truck/Bus

PAGE: 1
FILE: stnford
GCF : 1.03
DATE: 5/14/91

Time	From North			From East			From South			From West			Vehicle
Begin	RT	THRU	LT	RT	THRU	LT	RT	THRU	LT	RT	THRU	LT	Total
6:00	1	11	0	0	0	0	0	1	2	0	0	2	17
7:00	7	20	0	0	0	0	0	5	2	2	0	6	42
8:00	7	8	0	0	0	0	0	6	2	1	0	3	27
Break													
4:00	0	7	0	0	0	0	0	5	0	0	0	1	13
5:00	0	3	0	0	0	0	0	1	0	0	0	1	5
DAY TOTAL	15	49	0	0	0	0	0	18	6	3	0	13	104

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ite Code : 94900000                                                                       PAGE:  1
-S Street: BLOSSOM                                                                        FILE: blossom
-W Street: O'CONNOR WAY                                                                   GCF : 1.03
eather    : CLEAR                        Sum of the Cars and Truck/Bus
                                                                                          DATE:  5/09/91
-------------------------------------------------------------------------------------------------------------

                     PEAK PERIOD ANALYSIS FOR THE PERIOD:  7:00 AM -  9:00 AM

        DIRECTION    START       PEAK HR        ........ VOLUMES ........          .... PERCENTS ...
          FROM     PEAK HOUR     FACTOR        Right  Thru  Left   Total          Right  Thru  Left
        ---------------------------------------------------------------------------------------------
         North      8:00 AM       0.92            0    141    75    216              0    65    35
          East      7:45 AM       0.87          127      0    43    170             75     0    25
         South      8:00 AM       0.76           83    126     0    209             40    60     0
          West      8:00 AM       0.00            0      0     0      0              0     0     0

                                               Entire Intersection

         North      7:45 AM       0.90            0    132    77    209              0    63    37
          East                    0.87          127      0    43    170             75     0    25
         South                    0.76           82    126     0    208             39    61     0
          West                    0.00            0      0     0      0              0     0     0
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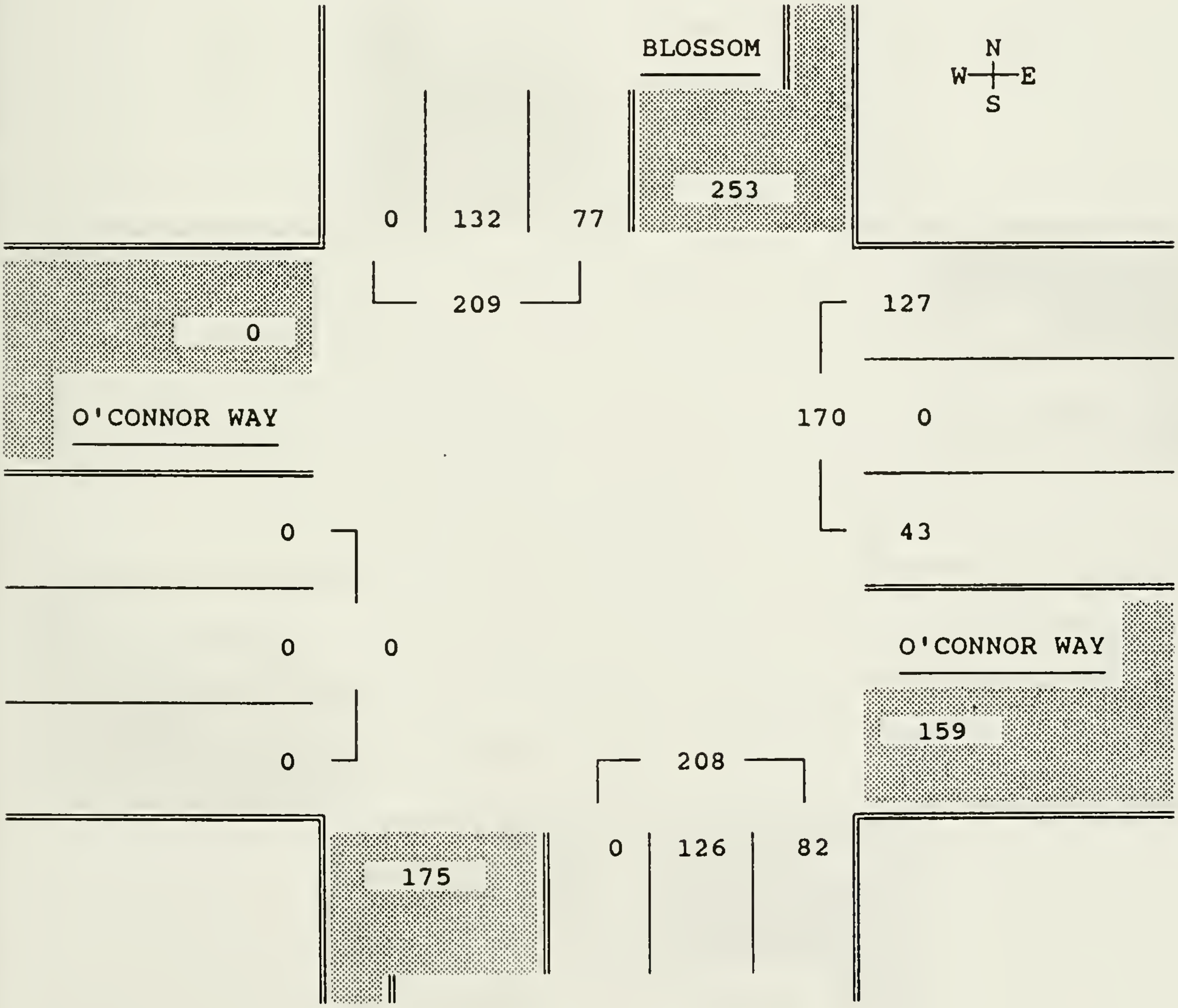


Site Code : 94900000
N-S Street: BLOSSOM
E-W Street: O'CONNOR WAY
Weather : CLEAR

Movements by: Cars

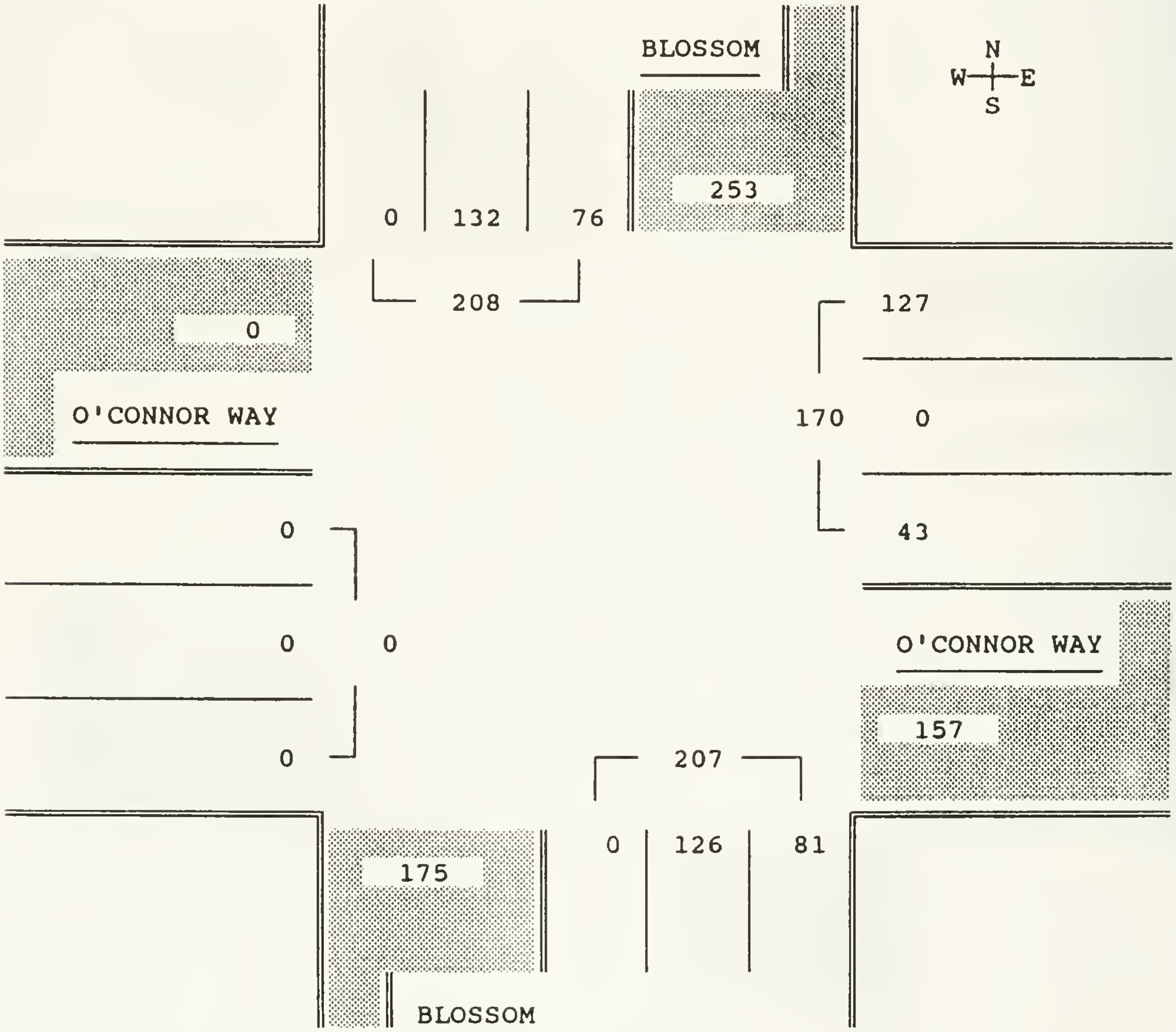
PAGE: 1
FILE: blossom
GCF : 1.03
DATE: 5/09/91

PEAK PERIOD ANALYSIS FOR THE PERIOD: 7:00 AM - 9:00 AM

DIRECTION FROM	START PEAK HOUR	PEAK HR FACTOR	VOLUMES Right	VOLUMES Thru	VOLUMES Left	VOLUMES Total	PERCENTS Right	PERCENTS Thru	PERCENTS Left
North	8:00 AM	0.92	0	141	75	216	0	65	35
East	7:45 AM	0.87	127	0	43	170	75	0	25
South	8:00 AM	0.76	83	126	0	209	40	60	0
West	8:00 AM	0.00	0	0	0	0	0	0	0

Entire Intersection

DIRECTION FROM	START PEAK HOUR	PEAK HR FACTOR	VOLUMES Right	VOLUMES Thru	VOLUMES Left	VOLUMES Total	PERCENTS Right	PERCENTS Thru	PERCENTS Left
North	7:45 AM	0.90	0	132	76	208	0	63	37
East		0.87	127	0	43	170	75	0	25
South		0.77	81	126	0	207	39	61	0
West		0.00	0	0	0	0	0	0	0



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ite Code : 94900000                                                                          PAGE:  1
-S Street: BLOSSOM                                                                           FILE: blossom
-W Street: O'CONNOR WAY                                                                      GCF : 1.03
eather   : CLEAR                            Movements by: Truck/Bus                          DATE:  5/09/91
------------------------------------------------------------------------------------------------------------

                        PEAK PERIOD ANALYSIS FOR THE PERIOD:  7:00 AM -  9:00 AM

         DIRECTION     START       PEAK HR          ........ VOLUMES ........          .... PERCENTS ...
           FROM      PEAK HOUR     FACTOR          Right  Thru  Left   Total          Right  Thru  Left
         ---------------------------------------------------------------------------------------------
          North       7:00 AM       0.25              0     0     1      1              0     0   %100
           East       7:00 AM       0.00              0     0     0      0              0     0     0
          South       7:00 AM       0.75              1     2   , 0      3             33    67     0
           Wast       7:00 AM       0.00              0     0     0      0              0     0     0

                                                 Entire Intersection

          North       7:00 AM       0.25              0     0     1      1              0     0   %100
           East                     0.00              0     0     0      0              0     0     0
          South                     0.75              1     2     0      3             33    67     0
           West                     0.00              0     0     0      0              0     0     0
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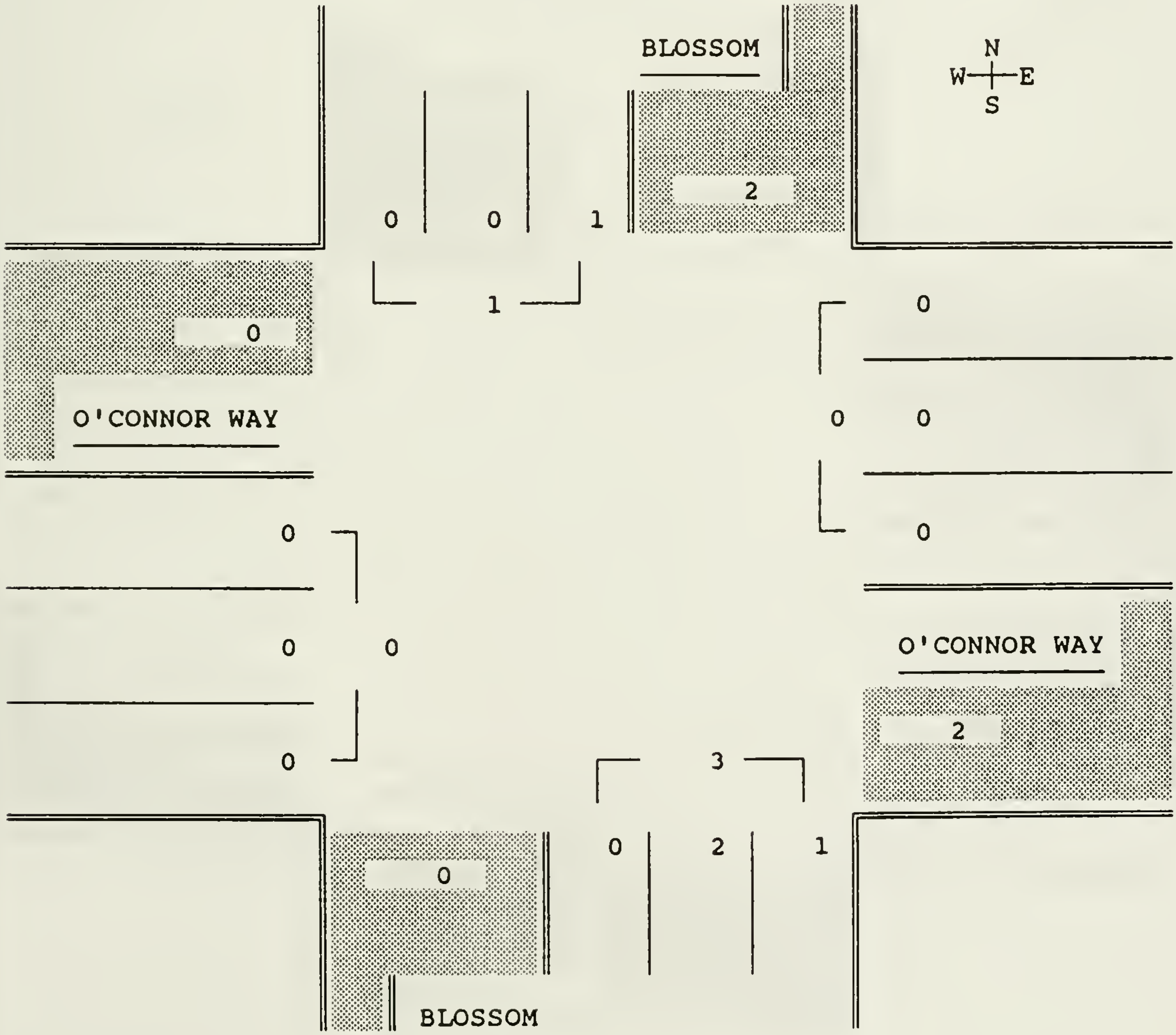

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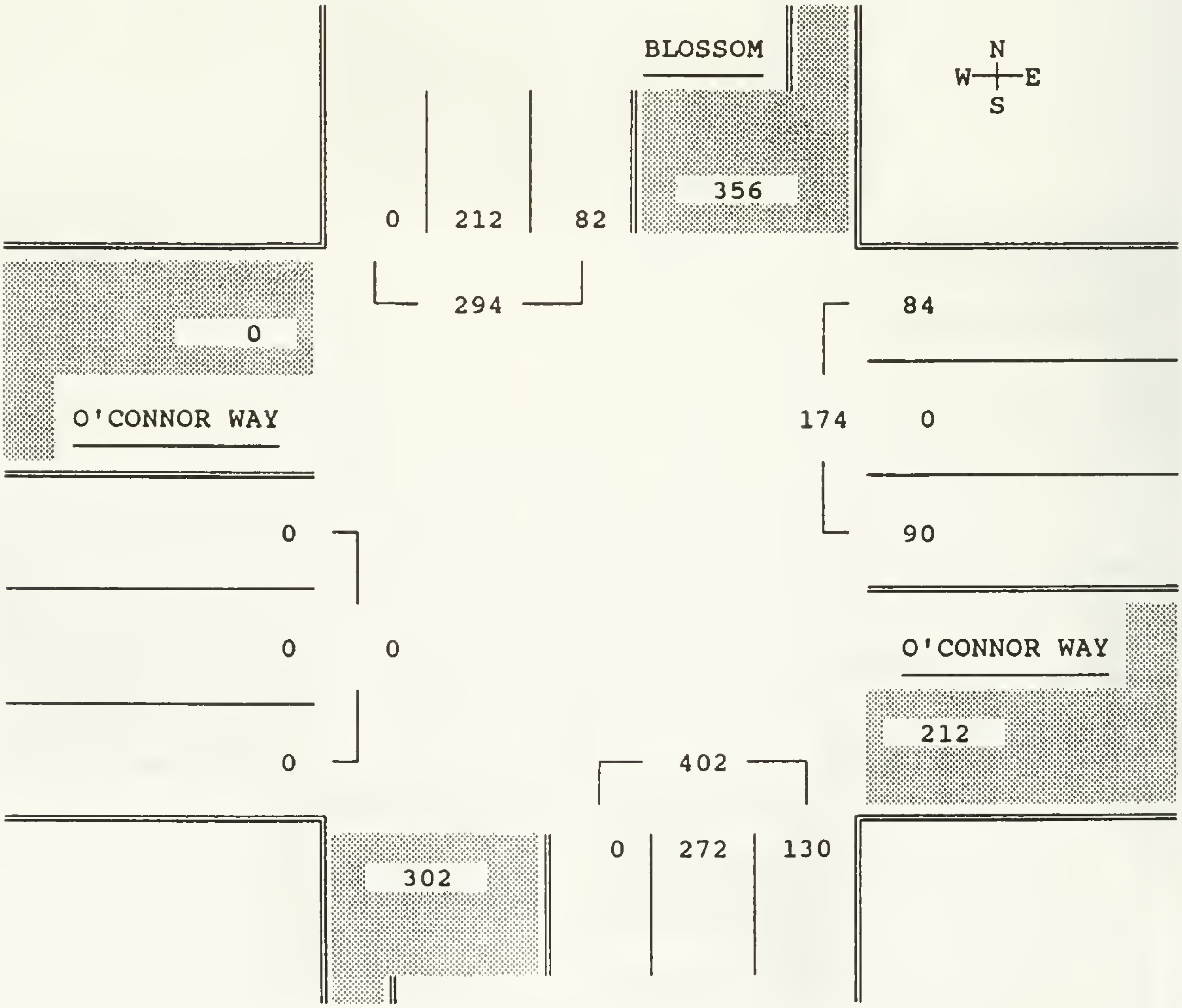
Site Code : 94900000                                                                      PAGE:  1
N-S Street: BLOSSOM                                                                       FILE: blossom
E-W Street: O'CONNOR WAY                                                                  GCF : 1.03
Weather   : CLEAR                         Sum of the Cars and Truck/Bus
                                                                                          DATE:  5/09/9
----------------------------------------------------------------------------------------------------

                      PEAK PERIOD ANALYSIS FOR THE PERIOD:  4:00 PM -  5:45 PM

          DIRECTION     START      PEAK HR          ........ VOLUMES ........        .... PERCENTS ...
            FROM      PEAK HOUR    FACTOR          Right  Thru  Left   Total         Right  Thru  Left
          ------------------------------------------------------------------------------------------
           North       4:30 PM      0.94               0   212    82     294             0    72    28
            East       4:45 PM      0.85              87     0 ,  96     183            48     0    52
           South       4:15 PM      0.96             132   281     0     413            32    68     0
            West       4:15 PM      0.00               0     0     0       0             0     0     0

                                               Entire Intersection

           North       4:30 PM      0.94               0   212    82     294             0    72    28
            East                    0.81              84     0    90     174            48     0    52
           South                    0.93             130   272     0     402            32    68     0
            West                    0.00               0     0     0       0             0     0     0
```



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te Code : 94900000                                                              PAGE:  1
S Street: BLOSSOM                                                               FILE: blossom
W Street: O'CONNOR WAY                                                          GCF : 1.03
eathar   : CLEAR                       Movements by: Cars                        DATE:  5/09/91
------------------------------------------------------------------------------------------------

                    PEAK PERIOD ANALYSIS FOR THE PERIOD:  4:00 PM -  5:45 PM

  DIRECTION     START      PEAK HR        ........ VOLUMES ........         .... PERCENTS ...
    FROM      PEAK HOUR    FACTOR        Right  Thru  Left   Total         Right  Thru  Left
  -----------------------------------------------------------------------------------------
   North       4:30 PM      0.94             0   212    82     294             0    72    28
    East       4:45 PM      0.85            87     0    96     183            48     0    52
   South       4:45 PM      0.93           134   279     0     413            32    68     0
    West       4:45 PM      0.00             0     0     0       0             0     0     0

                                       Entire Intersection

   North       4:30 PM      0.94             0   212    82     294             0    72    28
    East                    0.81            84     0    90     174            48     0    52
   South                    0.93           130   272     0     402            32    68     0
    West                    0.00             0     0     0       0             0     0     0
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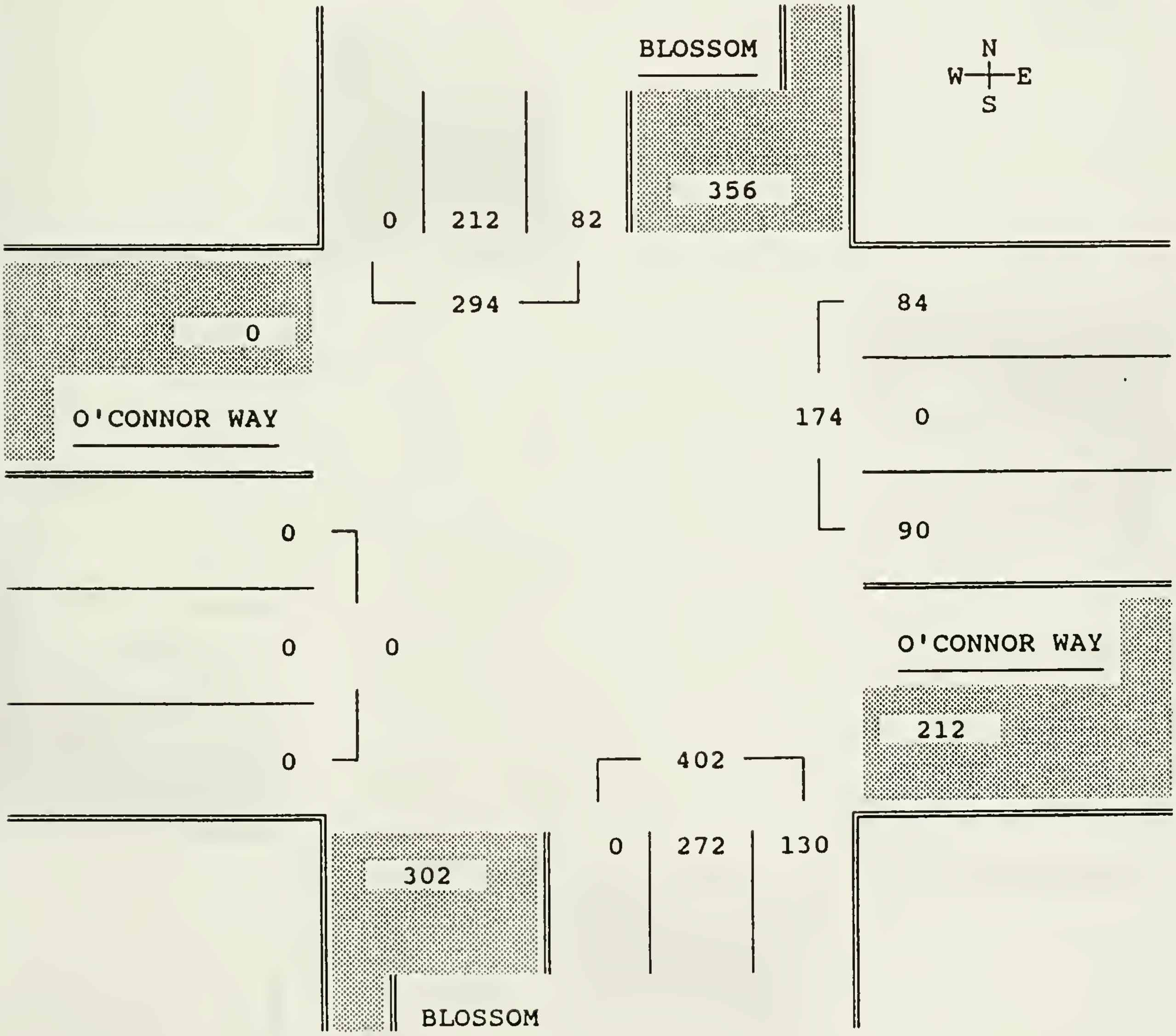


Site Code : 94900000
N-S Street: BLOSSOM
E-W Street: O'CONNOR WAY
Weather : CLEAR

Movements by: Truck/Bus

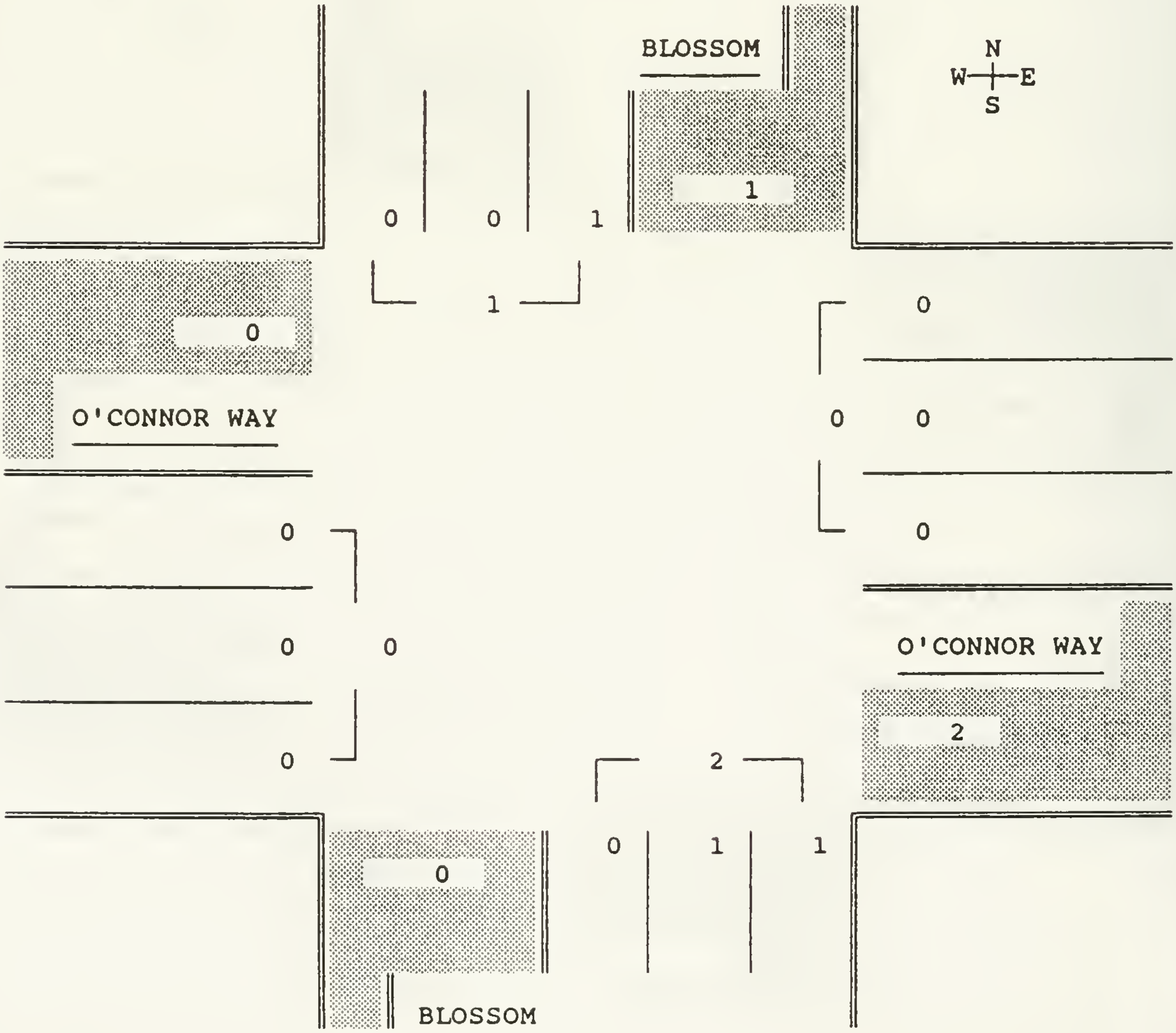
PAGE: 1
FILE: blossom
GCF : 1.03
DATE: 5/09/91

PEAK PERIOD ANALYSIS FOR THE PERIOD: 4:00 PM - 5:45 PM

DIRECTION FROM	START PEAK HOUR	PEAK HR FACTOR	.... VOLUMES .... Right	Thru	Left	Total	.... PERCENTS ... Right	Thru	Left
North	4:00 PM	0.25	0	0	1	1	0	0	%100
East	4:00 PM	0.00	0	0	0	0	0	0	0
South	4:00 PM	0.50	1	1	0	2	50	50	0
West	4:00 PM	0.00	0	0	0	0	0	0	0

Entire Intersection

DIRECTION FROM	START PEAK HOUR	PEAK HR FACTOR	Right	Thru	Left	Total	Right	Thru	Left
North	4:00 PM	0.25	0	0	1	1	0	0	%100
East		0.00	0	0	0	0	0	0	0
South		0.50	1	1	0	2	50	50	0
West		0.00	0	0	0	0	0	0	0



Site Code : 94900000
N-S Street: BLOSSOM
E-W Street: O'CONNOR WAY
Weather : CLEAR

PAGE: 1
FILE: blossom
GCF : 1.03

Sum of the Cars and Truck/Bus

DATE: 5/09/91

Time	From North			From East			From South			From West			Vehicle
Begin	RT	THRU	LT	RT	THRU	LT	RT	THRU	LT	RT	THRU	LT	Total
7:00 AM	0	32	9	46	0	10	7	28	0	0	0	0	132
7:15	0	23	12	20	0	9	9	18	0	0	0	0	91
7:30	0	24	12	24	0	9	18	30	0	0	0	0	117
7:45	0	31	21	40	0	9	26	42	0	0	0	0	169
HR TOTAL	0	110	54	130	0	37	60	118	0	0	0	0	509
8:00 AM	0	29	15	28	0	13	18	31	0	0	0	0	134
8:15	0	34	21	31	0	7	11	20	0	0	0	0	124
8:30	0	38	20	28	0	14	27	33	0	0	0	0	160
8:45	0	40	19	24	0	10	27	42	0	0	0	0	162
HR TOTAL	0	141	75	111	0	44	83	126	0	0	0	0	580
Break													
3:00 PM	0	50	18	28	0	18	21	40	0	0	0	0	175
3:15	0	48	23	16	0	5	21	41	0	0	0	0	154
3:30	0	75	24	10	0	24	15	48	0	0	0	0	196
3:45	0	41	26	19	0	31	22	57	0	0	0	0	196
HR TOTAL	0	214	91	73	0	78	79	186	0	0	0	0	721
4:00 PM	0	55	16	23	0	32	35	47	0	0	0	0	208
4:15	0	45	30	19	0	22	39	67	0	0	0	0	222
4:30	0	58	18	16	0	18	31	69	0	0	0	0	210
4:45	0	51	19	19	0	23	31	77	0	0	0	0	220
HR TOTAL	0	209	83	77	0	95	136	260	0	0	0	0	860
5:00 PM	0	44	26	24	0	20	31	68	0	0	0	0	213
5:15	0	59	19	25	0	29	37	58	0	0	0	0	227
5:30	0	31	23	19	0	24	35	76	0	0	0	0	208
DAY TOTAL	0	808	371	459	0	327	461	892	0	0	0	0	3318

Site Code : 94900000
N-S Street: BLOSSOM
E-W Street: O'CONNOR WAY
Weather : CLEAR

PAGE: 1
FILE: blossom
GCF : 1.03

Sum of the Cars and Truck/Bus

DATE: 5/09/91

Time	From North			From East			From South			From West			Vehicle
Begin	RT	THRU	LT	RT	THRU	LT	RT	THRU	LT	RT	THRU	LT	Total
7:00	0	110	54	130	0	37	60	118	0	0	0	0	509
8:00	0	141	75	111	0	44	83	126	0	0	0	0	580
Break													
3:00	0	214	91	73	0	78	79	186	0	0	0	0	721
4:00	0	209	83	77	0	95	136	260	0	0	0	0	860
DAY TOTAL	0	808	371	459	0	327	461	892	0	0	0	0	3318

Site Code : 94900000
N-S Street: BLOSSOM
E-W Street: O'CONNOR WAY
Weather : CLEAR

Movements by: Cars

PAGE: 1
FILE: blossom
GCF : 1.03
DATE: 5/09/91

Time	From North			From East			From South			From West			Vehicle
Begin	RT	THRU	LT	RT	THRU	LT	RT	THRU	LT	RT	THRU	LT	Total
7:00 AM	0	32	9	46	0	10	7	27	0	0	0	0	131
7:15	0	23	12	20	0	9	9	18	0	0	0	0	91
7:30	0	24	12	24	0	9	18	29	0	0	0	0	116
7:45	0	31	20	40	0	9	25	42	0	0	0	0	167
HR TOTAL	0	110	53	130	0	37	59	116	0	0	0	0	505
8:00 AM	0	29	15	28	0	13	18	31	0	0	0	0	134
8:15	0	34	21	31	0	7	11	20	0	0	0	0	124
8:30	0	38	20	28	0	14	27	33	0	0	0	0	160
8:45	0	40	19	24	0	10	27	42	0	0	0	0	162
HR TOTAL	0	141	75	111	0	44	83	126	0	0	0	0	580
Break													
3:00 PM	0	50	18	28	0	18	21	40	0	0	0	0	175
3:15	0	48	23	15	0	5	21	41	0	0	0	0	153
3:30	0	75	24	10	0	24	15	47	0	0	0	0	195
3:45	0	41	26	19	0	31	22	57	0	0	0	0	196
HR TOTAL	0	214	91	72	0	78	79	185	0	0	0	0	719
4:00 PM	0	55	16	23	0	32	35	46	0	0	0	0	207
4:15	0	45	29	19	0	22	38	67	0	0	0	0	220
4:30	0	58	18	16	0	18	31	69	0	0	0	0	210
4:45	0	51	19	19	0	23	31	77	0	0	0	0	220
HR TOTAL	0	209	82	77	0	95	135	259	0	0	0	0	857
5:00 PM	0	44	26	24	0	20	31	68	0	0	0	0	213
5:15	0	59	19	25	0	29	37	58	0	0	0	0	227
5:30	0	31	23	19	0	24	35	76	0	0	0	0	208
DAY TOTAL	0	808	369	458	0	327	459	888	0	0	0	0	3309

Site Code : 94900000
N-S Street: BLOSSOM
E-W Street: O'CONNOR WAY
Weather : CLEAR

Movements by: Cars

PAGE: 1
FILE: blossom
GCF : 1.03
DATE: 5/09/91

Time	From North			From East			From South			From West			Vehicle
Begin	RT	THRU	LT	RT	THRU	LT	RT	THRU	LT	RT	THRU	LT	Total
7:00	0	110	53	130	0	37	59	116	0	0	0	0	505
8:00	0	141	75	111	0	44	83	126	0	0	0	0	580
Break													
3:00	0	214	91	72	0	78	79	185	0	0	0	0	719
4:00	0	209	82	77	0	95	135	259	0	0	0	0	857
DAY TOTAL	0	808	369	458	0	327	459	888	0	0	0	0	3309

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Site Code : 94900000                                                                                      PAGE:  1
N-S Street: BLOSSOM                                                                                       FILE: blossom
E-W Street: O'CONNOR WAY                                                                                  GCF : 1.03
Weather   : CLEAR                                  Movements by: Truck/Bus                                DATE:  5/09/91
------------------------------------------------------------------------------------------------------------------------
Time                From North              From East              From South              From West          Vehicle
Begin             RT   THRU   LT         RT   THRU   LT          RT   THRU   LT          RT   THRU   LT       Total
------------------------------------------------------------------------------------------------------------------------
 7:00 AM           0     0     0          0     0     0           0     1     0           0     0     0          1

------------------------------------------------------ Break -----------------------------------------------------------

 7:30              0     0     0          0     0     0           0     1     0           0     0     0          1
 7:45              0     0     1          0     0     0           1     0     0           0     0     0          2
HR TOTAL           0     0     1          0     0     0           1     2     0           0     0     0          4


------------------------------------------------------ Break -----------------------------------------------------------

 3:15              0     0     0          1     0     0           0     0     0           0     0     0          1
 3:30              0     0     0          0     0     0           0     1     0           0     0     0          1

------------------------------------------------------ Break -----------------------------------------------------------

 4:00 PM           0     0     0          0     0     0           0     1     0           0     0     0          1
 4:15              0     0     1          0     0     0           1     0     0           0     0     0          2

------------------------------------------------------ Break -----------------------------------------------------------


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DAY TOTAL          0     0     2          1     0     0           2     4     0           0     0     0          9
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Site Code : 94900000                                                                                  PAGE:  1
N-S Street: BLOSSOM                                                                                   FILE: blossom
E-W Street: O'CONNOR WAY                                                                              GCF : 1.03
Weather   : CLEAR                                     Movements by: Truck/Bus                         DATE:  5/09/91
------------------------------------------------------------------------------------------------------------------
Time                From North              From East              From South              From West        Vehicle
Begin             RT   THRU   LT         RT   THRU   LT         RT   THRU   LT         RT   THRU   LT        Total
------------------------------------------------------------------------------------------------------------------
 7:00              0     0     1          0     0     0          1     2     0          0     0     0           4


--------------------------------------------------------- Break ---------------------------------------------------

 3:00              0     0     0          1     0     0          0     1     0          0     0     0           2

 4:00              0     0     1          0     0     0          1     1     0          0     0     0           3


------------------------------------------------------------------------------------------------------------------


DAY TOTAL          0     0     2          1     0     0          2     4     0          0     0     0           9
```

ite Code : 11111111
-S Street: BLOSSOM ST/GARDEN ST
E-W Street: CAMBRIDGE ST
Weather : CLEAR

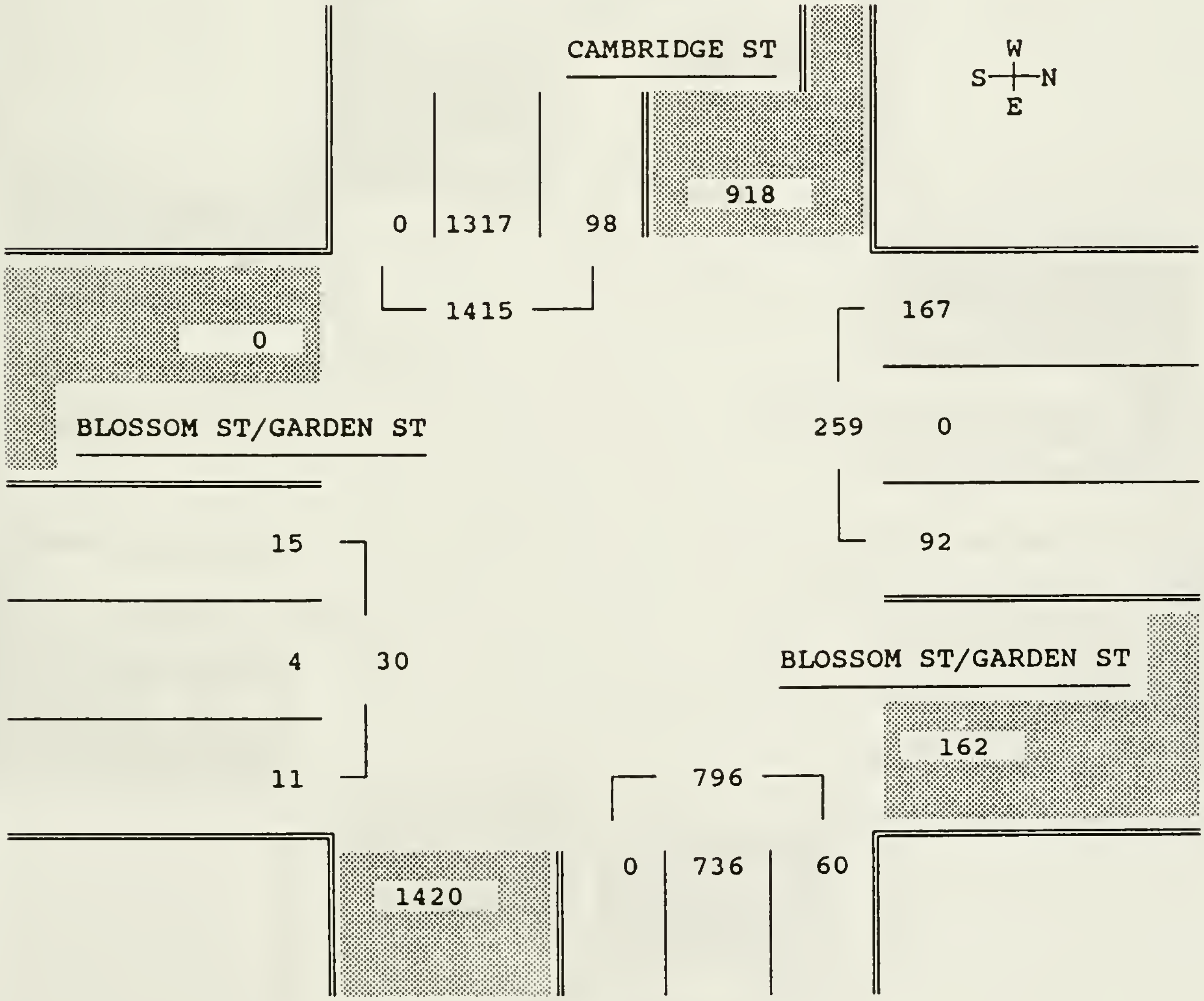
Sum of the Cars and Truck/Bus

FILE: CAMBLSMA
GCF : 1.03

DATE: 5/14/91

PEAK PERIOD ANALYSIS FOR THE PERIOD: 6:30 AM - 9:00 AM

DIRECTION FROM	START PEAK HOUR	PEAK HR FACTOR	VOLUMES Right	VOLUMES Thru	VOLUMES Left	VOLUMES Total	PERCENTS Right	PERCENTS Thru	PERCENTS Left
West	7:45 AM	0.94	0	1351	93	1444	0	94	6
North	8:00 AM	0.89	167	0	92	259	64	0	36
East	8:00 AM	0.97	60	736	0	796	8	92	0
South	7:45 AM	0.82	8	6	19	33	24	18	58
Entire Intersection									
West	8:00 AM	0.98	0	1317	98	1415	0	93	7
North		0.89	167	0	92	259	64	0	36
East		0.97	60	736	0	796	8	92	0
South		0.75	11	4	15	30	37	13	50



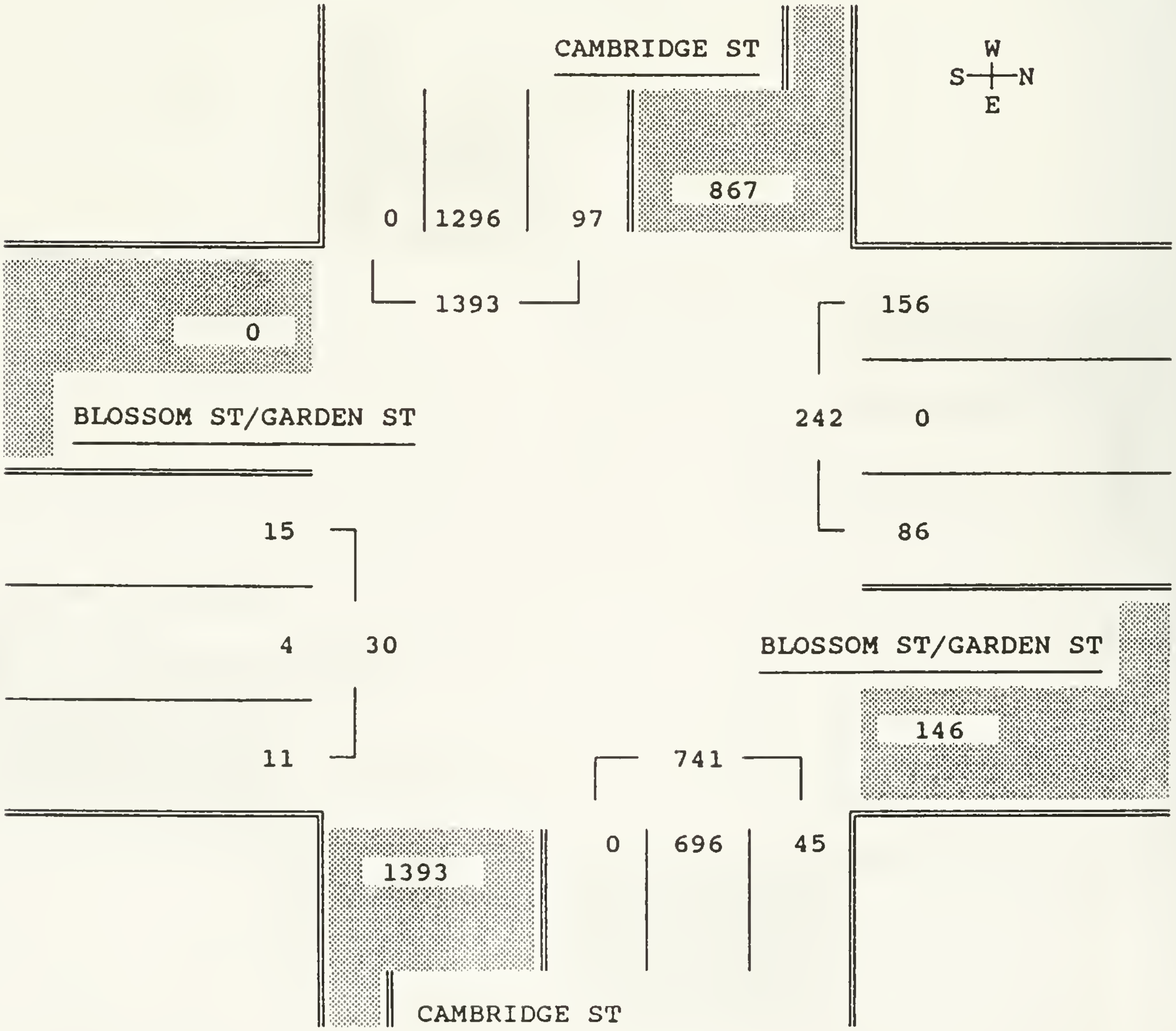
Site Code : 11111111
N-S Street: BLOSSOM ST/GARDEN ST
E-W Street: CAMBRIDGE ST
Weather : CLEAR

Movements by: Cars

PAGE: 1
FILE: CAMBLSMA
GCF : 1.03
DATE: 5/14/91

PEAK PERIOD ANALYSIS FOR THE PERIOD: 6:30 AM - 9:00 AM

DIRECTION FROM	START PEAK HOUR	PEAK HR FACTOR	VOLUMES Right	Thru	Left	Total	PERCENTS Right	Thru	Left
West	7:45 AM	0.94	0	1327	93	1420	0	93	7
North	8:00 AM	0.88	156	0	86	242	64	0	36
East	8:00 AM	0.99	45	696	0	741	6	94	0
South	7:45 AM	0.82	8	6	19	33	24	18	58
Entire Intersection									
West	8:00 AM	0.98	0	1296	97	1393	0	93	7
North		0.88	156	0	86	242	64	0	36
East		0.99	45	696	0	741	6	94	0
South		0.75	11	4	15	30	37	13	50



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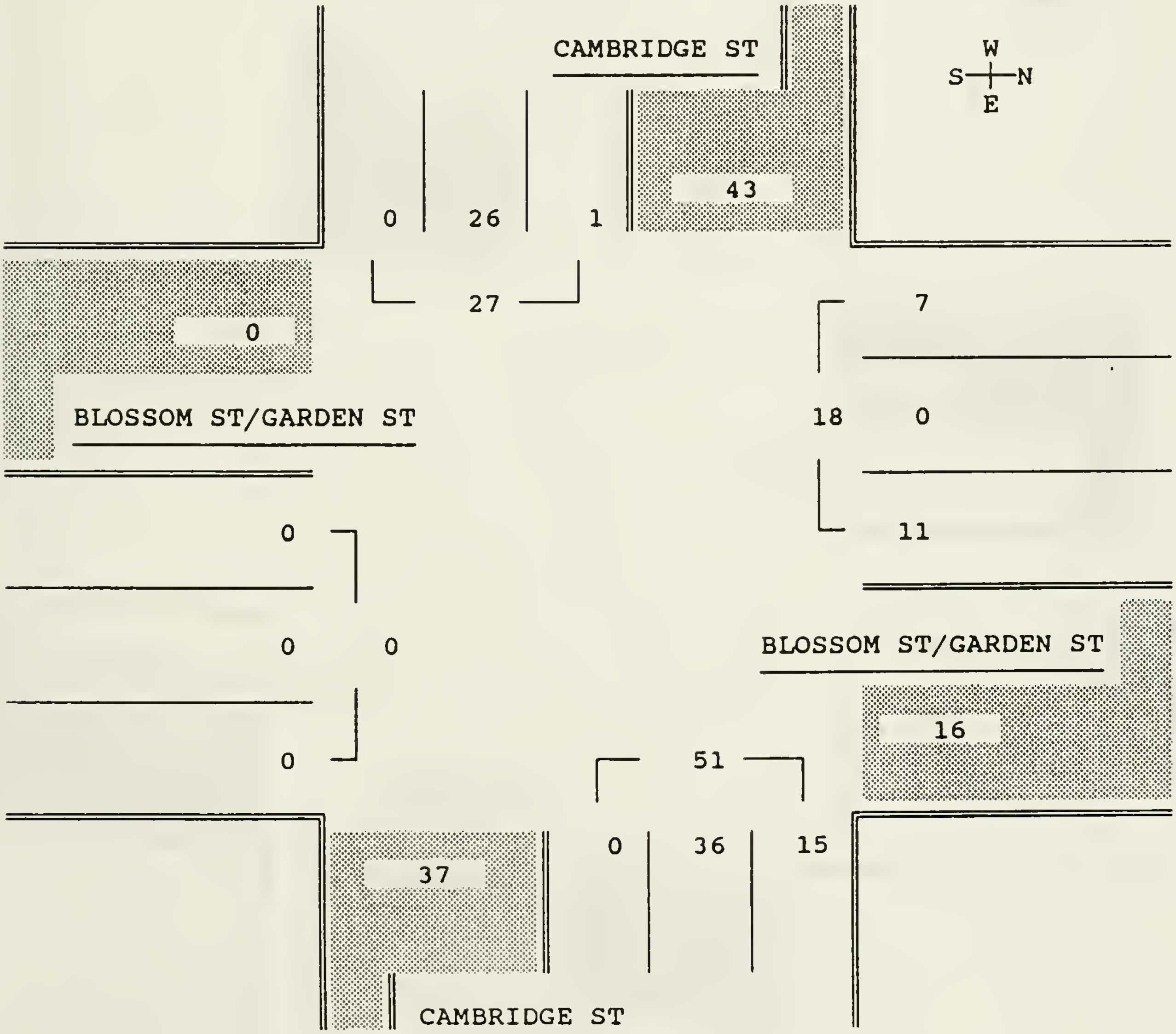
Site Code : 11111111                                                                                    PAGE:  1
N-S Street: BLOSSOM ST/GARDEN ST                                                                        FILE: CAMBLSMA
E-W Street: CAMBRIDGE ST                                                                                GCF : 1.03
Weather   : CLEAR                                  Movements by: Truck/Bus                              DATE:  5/14/91
-----------------------------------------------------------------------------------------------------------------------

                              PEAK PERIOD ANALYSIS FOR THE PERIOD:  6:30 AM -  9:00 AM

            DIRECTION     START       PEAK HR          ........ VOLUMES ........          .... PERCENTS ...
              FROM      PEAK HOUR     FACTOR          Right  Thru  Left   Total         Right  Thru  Left
            -----------------------------------------------------------------------------------------------
              West       7:30 AM       0.84              0    26     1      27              0    96     4
             North       7:45 AM       0.71             10     0    10      20             50     0    50
              East       7:15 AM       0.84             17    37     0      54             31    69     0
             South       6:30 AM       0.25              1     0     0       1           %100     0     0

                                                    Entire Intersection

              West       7:30 AM       0.84              0    26     1      27              0    96     4
             North                     0.64              7     0    11      18             39     0    61
              East                     0.80             15    36     0      51             29    71     0
             South                     0.00              0     0     0       0              0     0     0
```



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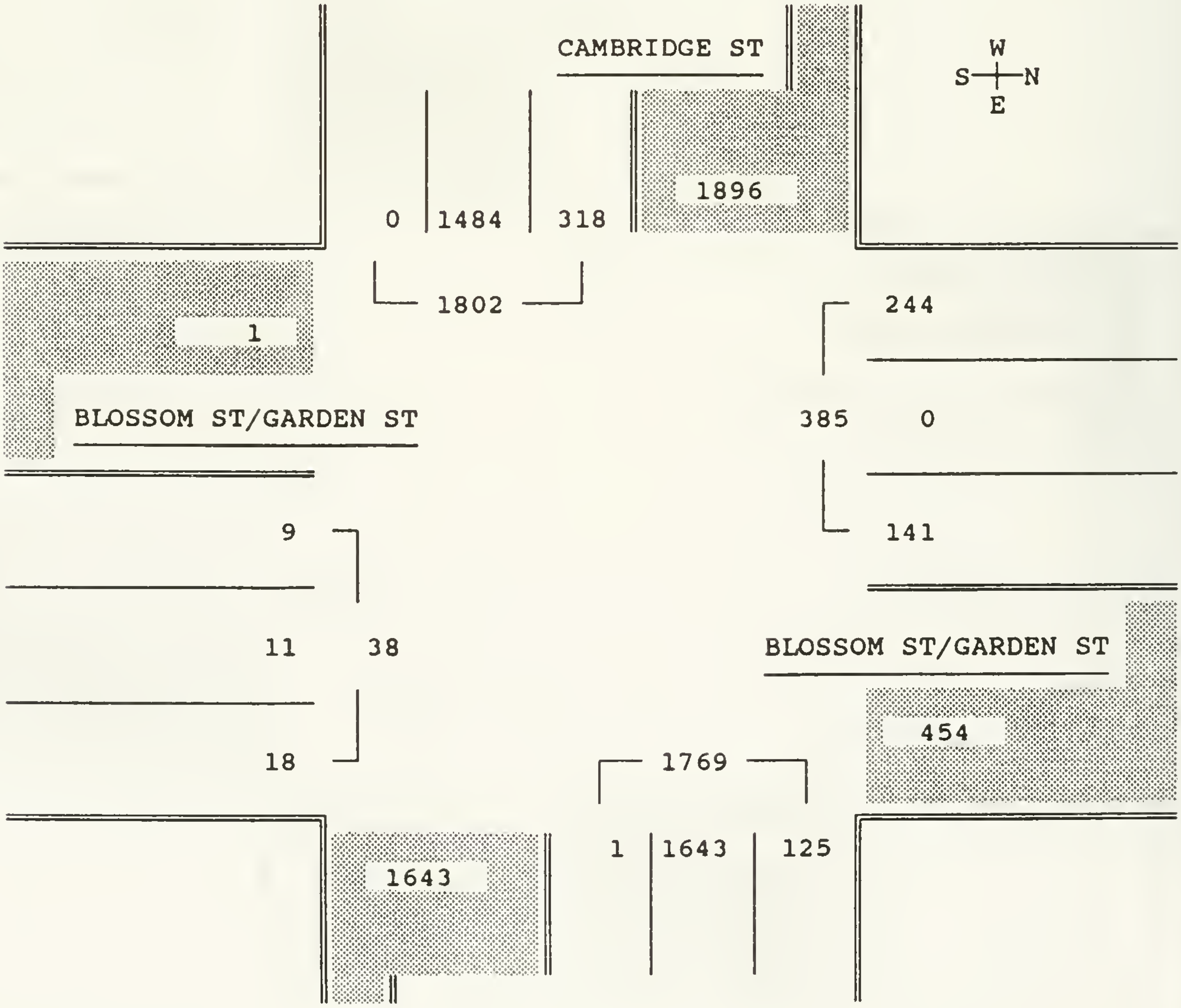
Site Code : 94900000                                                                    PAGE:  1
N-S Street: BLOSSOM ST/GARDEN ST                                                        FILE: camblsmp
E-W Street: CAMBRIDGE ST                                                                GCF : 1.03
Weather   : CLEAR                          Sum of the Cars and Truck/Bus
                                                                                        DATE:  5/16/91
-----------------------------------------------------------------------------------------------------

                        PEAK PERIOD ANALYSIS FOR THE PERIOD:  3:00 PM -  6:00 PM

          DIRECTION     START      PEAK HR       ........ VOLUMES ........       .... PERCENTS ...
            FROM      PEAK HOUR    FACTOR       Right  Thru  Left   Total       Right  Thru  Left
          -----------------------------------------------------------------------------------
            West       4:45 PM      0.92            0  1455   348    1803          0    81    19
            North      4:30 PM      0.88          248     0   185     433         57     0    43
            East       5:00 PM      0.88          125  1643     1    1769          7    93     0
            South      4:45 PM      0.77           25    14    10      49         51    29    20

                                              Entire Intersection

            West       5:00 PM      0.92            0  1484   318    1802          0    82    18
            North                   0.78          244     0   141     385         63     0    37
            East                    0.88          125  1643     1    1769          7    93     0
            South                   0.73           18    11     9      38         47    29    24
```



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Site Code : 94900000                                                                    PAGE:  1
N-S Street: BLOSSOM ST/GARDEN ST                                                        FILE: camblsmp
E-W Street: CAMBRIDGE ST                                                                GCF : 1.03
Weather   : CLEAR                           Movements by: Cars                          DATE:  5/16/91
-----------------------------------------------------------------------------------------------------

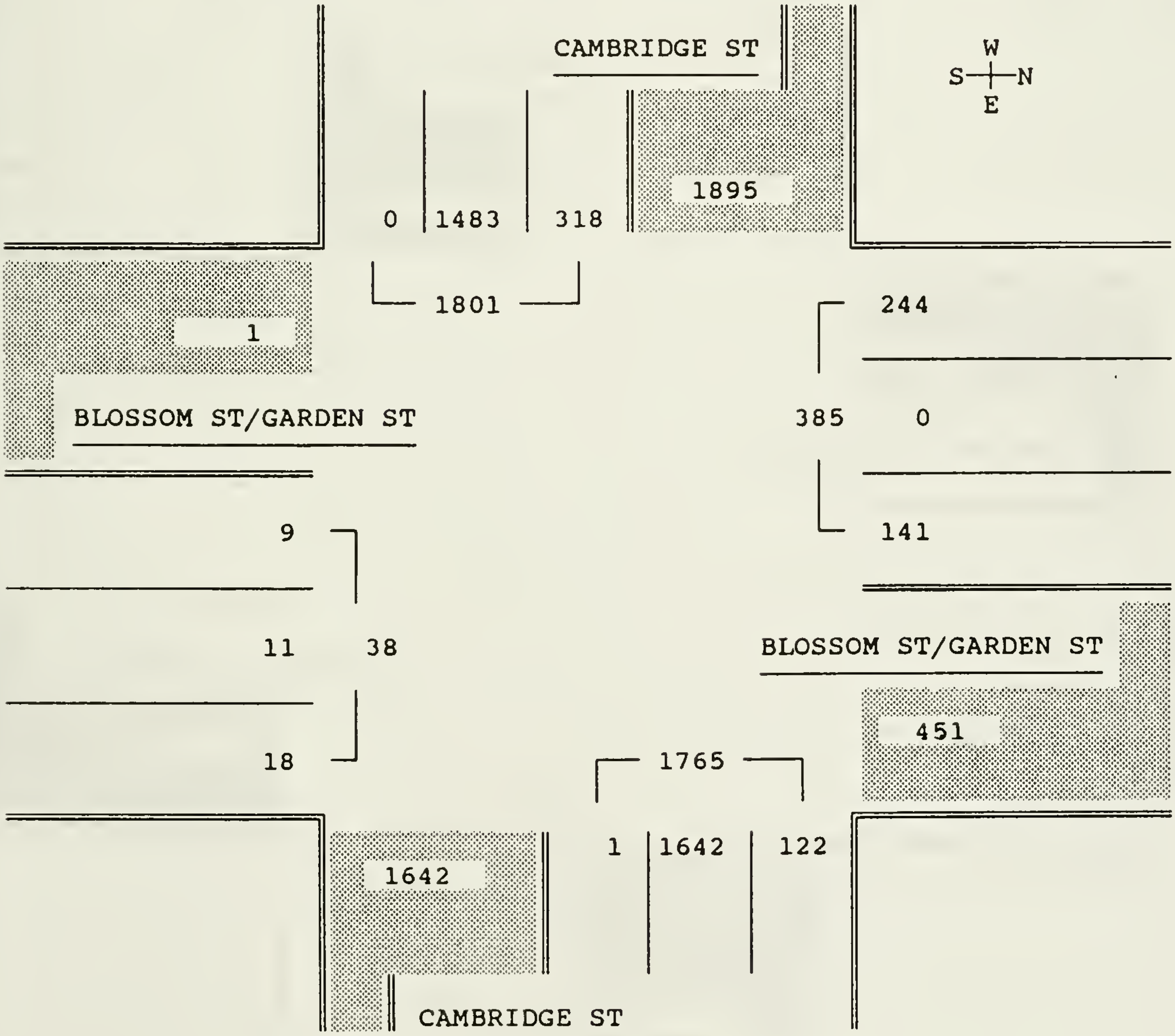
                       PEAK PERIOD ANALYSIS FOR THE PERIOD:  3:00 PM -  6:00 PM

         DIRECTION     START       PEAK HR           ........ VOLUMES ........         .... PERCENTS ...
           FROM      PEAK HOUR     FACTOR          Right  Thru  Left   Total         Right  Thru  Left
         -----------------------------------------------------------------------------------------------

           West       4:45 PM       0.92               0  1453   348    1801             0    81    19
          North       4:30 PM       0.88             248     0   185     433            57     0    43
           East       5:00 PM       0.88             122  1642 ,   1    1765             7    93     0
          South       4:45 PM       0.77              25    14    10      49            51    29    20

                                                 Entire Intersection

           West       5:00 PM       0.92               0  1483   318    1801             0    82    18
          North                     0.78             244     0   141     385            63     0    37
           East                     0.88             122  1642     1    1765             7    93     0
          South                     0.73              18    11     9      38            47    29    24
```



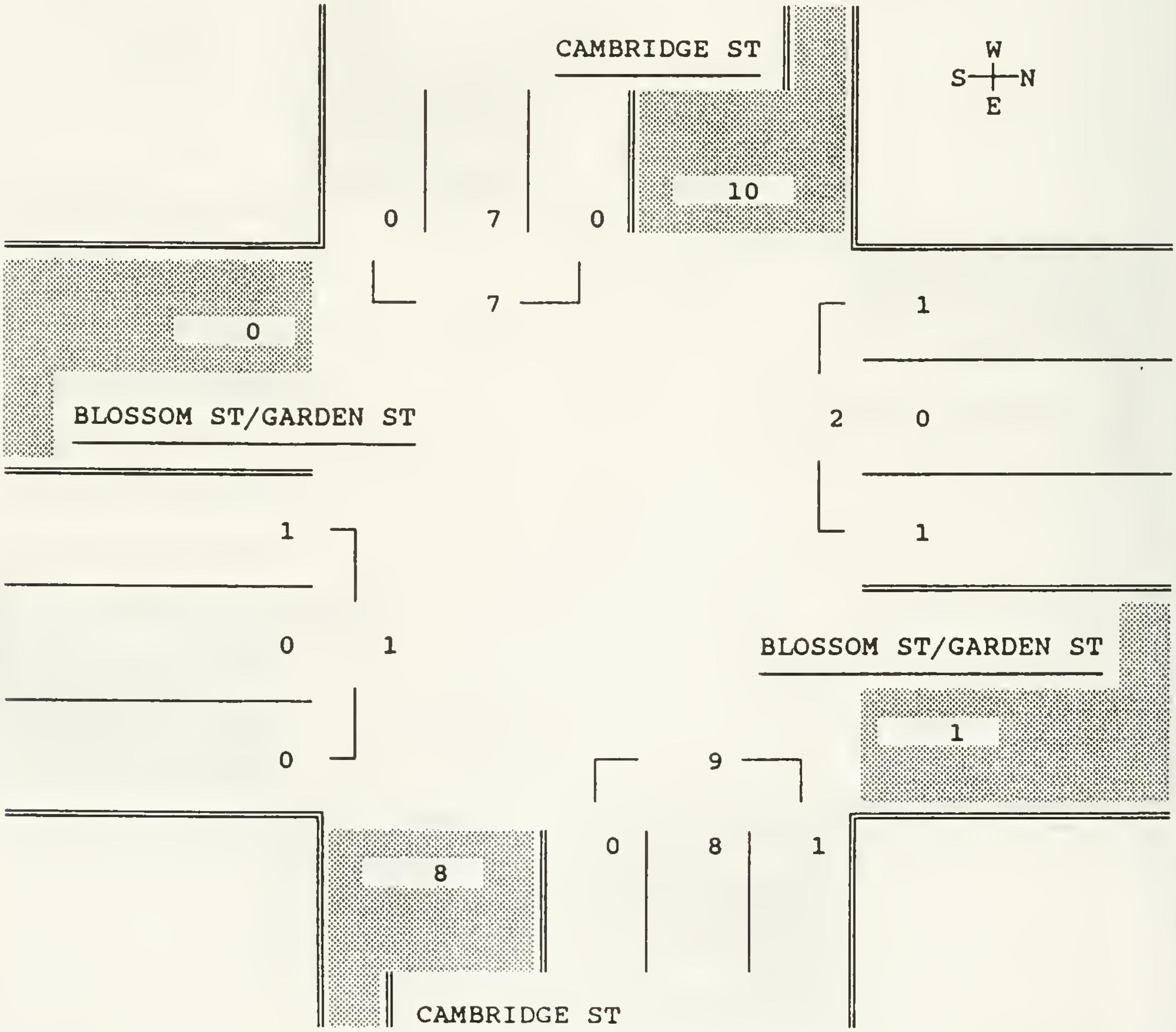
Site Code : 94900000
N-S Street: BLOSSOM ST/GARDEN ST
E-W Street: CAMBRIDGE ST
Weather : CLEAR

Movements by: Truck/Bus

PAGE: 1
FILE: camblsm
GCF : 1.03
DATE: 5/16/9

PEAK PERIOD ANALYSIS FOR THE PERIOD: 3:00 PM - 6:00 PM

DIRECTION FROM	START PEAK HOUR	PEAK HR FACTOR	VOLUMES Right	VOLUMES Thru	VOLUMES Left	VOLUMES Total	PERCENTS Right	PERCENTS Thru	PERCENTS Left
West	3:00 PM	0.35	0	7	0	7	0	%100	0
North	3:00 PM	0.25	1	0	1	2	50	0	50
East	3:00 PM	0.75	1	8	0	9	11	89	0
South	3:00 PM	0.25	0	0	1	1	0	0	%100
Entire Intersection									
West	3:00 PM	0.35	0	7	0	7	0	%100	0
North		0.25	1	0	1	2	50	0	50
East		0.75	1	8	0	9	11	89	0
South		0.25	0	0	1	1	0	0	%100



Site Code : 11111111
N-S Street: BLOSSOM ST/GARDEN ST
E-W Street: CAMBRIDGE ST
Weather : CLEAR

Sum of the Cars and Truck/Bus

PAGE: 1
FILE: camblsma
GCF : 1.03

DATE: 5/14/91

Time	From West			From North			From East			From South			Vehicle
Begin	RT	THRU	LT	RT	THRU	LT	RT	THRU	LT	RT	THRU	LT	Total
6:30	0	101	6	12	0	10	10	71	0	0	0	1	211
6:45	0	145	11	15	0	16	10	101	0	2	0	0	300
HR TOTAL	0	246	17	27	0	26	20	172	0	2	0	1	511
7:00 AM	0	178	11	26	0	12	16	102	0	3	1	1	350
7:15	0	236	12	23	0	12	16	122	0	1	3	2	427
7:30	0	282	25	30	0	23	15	148	0	3	3	2	531
7:45	0	362	23	41	0	24	25	146	0	0	2	6	629
HR TOTAL	0	1058	71	120	0	71	72	518	0	7	9	11	1937
8:00 AM	0	340	21	41	0	27	12	184	0	4	0	2	631
8:15	0	334	21	31	0	21	14	186	0	0	4	6	617
8:30	0	315	28	45	0	21	15	179	0	4	0	5	612
8:45	0	328	28	50	0	23	19	187	0	3	0	2	640
HR TOTAL	0	1317	98	167	0	92	60	736	0	11	4	15	2500
DAY TOTAL	0	2621	186	314	0	189	152	1426	0	20	13	27	4948

Site Code : 11111111
N-S Street: BLOSSOM ST/GARDEN ST
E-W Street: CAMBRIDGE ST
Weather : CLEAR

PAGE: 1
FILE: camblsm
GCF : 1.03
DATE: 5/14/9

Sum of the Cars and Truck/Bus

Time	From West			From North			From East			From South			Vehicle
Begin	RT	THRU	LT	RT	THRU	LT	RT	THRU	LT	RT	THRU	LT	Total
6:00	0	246	17	27	0	26	20	172	0	2	0	1	511
7:00	0	1058	71	120	0	71	72	518	0	7	9	11	1937
8:00	0	1317	98	167	0	92	60	736	0	11	4	15	2500
DAY TOTAL	0	2621	186	314	0	189	152	1426	0	20	13	27	4948

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Site Code : 11111111                                                                          PAGE:  1
N-S Street: BLOSSOM ST/GARDEN ST                                                              FILE: camblsma
E-W Street: CAMBRIDGE ST                                                                      GCF : 1.03
Weather   : CLEAR                             Movements by: Cars                              DATE:  5/14/91
-------------------------------------------------------------------------------------------------------------
Time              From West               From North              From East               From South       Vehicle
Begin          RT   THRU   LT          RT   THRU   LT          RT   THRU   LT          RT   THRU   LT       Total
-------------------------------------------------------------------------------------------------------------
 6:30           0    100    6          10     0     9           7     66    0           0     0     1        199
 6:45           0    144   11          13     0    14           7     92    0           2     0     0        283
HR TOTAL         0    244   17          23     0    23          14    158    0           2     0     1        482

 7:00 AM        0    172   10          24     0    10          15     92    0           2     1     1        327
 7:15           0    234   12          21     0    12      ,   12    110    0           1     3     2        407
 7:30           0    278   24          30     0    21          10    138    0           3     3     2        509
 7:45           0    354   23          39     0    19          22    141    0           0     2     6        606
HR TOTAL .       0   1038   69         114     0    62          59    481    0           6     9    11       1849

 8:00 AM        0    333   21          39     0    24           7    173    0           4     0     2        603
 8:15           0    325   21          28     0    20          12    176    0           0     4     6        592
 8:30           0    315   28          42     0    20          14    171    0           4     0     5        599
 8:45           0    323   27          47     0    22          12    176    0           3     0     2        612
HR TOTAL         0   1296   97         156     0    86          45    696    0          11     4    15       2406


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DAY TOTAL        0   2578  183         293     0   171         118   1335    0          19    13    27       4737
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Site Code : 11111111                                                                                      PAGE:  1
N-S Street: BLOSSOM ST/GARDEN ST                                                                          FILE: camblsm
E-W Street: CAMBRIDGE ST                                                                                  GCF : 1.03
Weather   : CLEAR                                      Movements by: Cars                                 DATE:  5/14/9
--------------------------------------------------------------------------------------------------------------------------
Time                   From West                From North                From East                From South       Vehicle
Begin              RT   THRU   LT           RT   THRU   LT           RT   THRU   LT           RT   THRU   LT       Total
--------------------------------------------------------------------------------------------------------------------------
 6:00               0    244   17           23     0    23           14    158    0            2     0     1         482

 7:00               0   1038   69          114     0    62           59    481    0            6     9    11        1849

 8:00               0   1296   97          156     0    86           45    696    0           11     4    15        2406


--------------------------------------------------------------------------------------------------------------------------

DAY TOTAL           0   2578  183          293     0   171          118   1335    0           19    13    27        4737
```

Site Code : 11111111
N-S Street: BLOSSOM ST/GARDEN ST
E-W Street: CAMBRIDGE ST
Weather : CLEAR

Movements by: Truck/Bus

FILE: camblsma
GCF : 1.03
DATE: 5/14/91

Time	From West			From North			From East			From South			Vehicle
Begin	RT	THRU	LT	RT	THRU	LT	RT	THRU	LT	RT	THRU	LT	Total
6:30	0	1	0	2	0	1	3	5	0	0	0	0	12
6:45	0	1	0	2	0	2	3	9	0	0	0	0	17
HR TOTAL	0	2	0	4	0	3	6	14	0	0	0	0	29
7:00 AM	0	6	1	2	0	2	1	10	0	1	0	0	23
7:15	0	2	0	2	0	0	4	11	0	0	0	0	19
7:30	0	4	1	0	0	2	5	10	0	0	0	0	22
7:45	0	7	0	2	0	5	3	5	0	0	0	0	22
HR TOTAL	0	19	2	6	0	9	13	36	0	1	0	0	86
8:00 AM	0	7	0	2	0	3	5	11	0	0	0	0	28
8:15	0	8	0	3	0	1	2	10	0	0	0	0	24
8:30	0	0	0	3	0	1	1	8	0	0	0	0	13
8:45	0	4	1	3	0	1	6	11	0	0	0	0	26
HR TOTAL	0	19	1	11	0	6	14	40	0	0	0	0	91
DAY TOTAL	0	40	3	21	0	18	33	90	0	1	0	0	206

```
Site Code : 11111111                                                                                          PAGE:  1
N-S Street: BLOSSOM ST/GARDEN ST                                                                              FILE: camblsma
E-W Street: CAMBRIDGE ST                                                                                      GCF : 1.03
Weather   : CLEAR                             Movements by: Truck/Bus                                         DATE:  5/14/91
-------------------------------------------------------------------------------------------------------------------------
Time                From West                  From North                 From East                  From South      Vehicle
Begin            RT   THRU   LT             RT   THRU   LT             RT   THRU   LT             RT   THRU   LT      Total
-------------------------------------------------------------------------------------------------------------------------
 6:00             0     2     0              4     0     3              6    14     0              0     0     0        29

 7:00             0    19     2              6     0     9             13    36     0              1     0     0        86

 8:00             0    19     1             11     0     6             14    40     0              0     0     0        91


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DAY TOTAL          0    40     3             21     0    18             33    90     0              1     0     0       206
```

Site Code : 94900000
N-S Street: BLOSSOM ST/GARDEN ST
E-W Street: CAMBRIDGE ST
Weather : CLEAR

Sum of the Cars and Truck/Bus

PAGE: 1
FILE: camblsmp
GCF : 1.03

DATE: 5/16/91

Time	From West			From North			From East			From South			Vehicle
Begin	RT	THRU	LT	RT	THRU	LT	RT	THRU	LT	RT	THRU	LT	Total
3:00 PM	0	244	37	62	0	46	10	240	0	8	1	5	653
3:15	0	339	32	47	0	32	11	243	2	3	2	2	713
3:30	0	310	48	68	0	42	13	256	1	3	1	2	744
3:45	0	298	54	63	2	42	14	280	0	6	1	4	764
HR TOTAL	0	1191	171	240	2	162	48	1019	3	20	5	13	2874
4:00 PM	0	356	41	55	0	48	18	281	0	6	3	5	813
4:15	0	293	31	60	0	50	18	316	1	2	1	0	772
4:30	0	279	57	51	0	40	29	302	1	2	0	2	763
4:45	0	335	72	57	0	55	19	318	0	10	5	1	872
HR TOTAL	0	1263	201	223	0	193	84	1217	2	20	9	8	3220
5:00 PM	0	352	123	66	0	41	13	390	0	3	3	3	994
5:15	0	409	79	74	0	49	39	440	0	7	3	1	1101
5:30	0	359	74	49	0	28	55	446	1	5	3	5	1025
5:45	0	364	42	55	0	23	18	367	0	3	2	0	874
IR TOTAL	0	1484	318	244	0	141	125	1643	1	18	11	9	3994
AY TOTAL	0	3938	690	707	2	496	257	3879	6	58	25	30	10088

Site Code : 94900000
N-S Street: BLOSSOM ST/GARDEN ST
E-W Street: CAMBRIDGE ST
Weather : CLEAR

Sum of the Cars and Truck/Bus

PAGE: 1
FILE: camblsmp
GCF : 1.03

DATE: 5/16/91

Time	From West			From North			From East			From South			Vehicle
Begin	RT	THRU	LT	RT	THRU	LT	RT	THRU	LT	RT	THRU	LT	Total
3:00	0	1191	171	240	2	162	48	1019	3	20	5	13	2874
4:00	0	1263	201	223	0	193	84	1217	2	20	9	8	3220
5:00	0	1484	318	244	0	141	125	1643	1	18	11	9	3994
DAY TOTAL	0	3938	690	707	2	496	257	3879	6	58	25	30	10088

Site Code : 94900000
N-S Street: BLOSSOM ST/GARDEN ST
E-W Street: CAMBRIDGE ST
Weather : CLEAR

Movements by: Cars

PAGE: 1
FILE: camblsmp
GCF : 1.03
DATE: 5/16/91

Time	From West			From North			From East			From South			Vehicle
Begin	RT	THRU	LT	RT	THRU	LT	RT	THRU	LT	RT	THRU	LT	Total
3:00 PM	0	243	37	62	0	46	9	238	0	8	1	4	648
3:15	0	334	32	47	0	32	11	241	2	3	2	2	706
3:30	0	309	48	67	0	41	13	254	1	3	1	2	739
3:45	0	298	54	63	2	42	14	278	0	6	1	4	762
HR TOTAL	0	1184	171	239	2	161	47	1011	3	20	5	12	2855
4:00 PM	0	356	40	55	0	48	18	280	0	6	3	5	811
4:15	0	290	31	60	0	50	18	316	1	2	1	0	769
4:30	0	279	57	51	0	40	29	301	1	2	0	2	762
4:45	0	334	72	57	0	55	19	317	0	10	5	1	870
HR TOTAL	0	1259	200	223	0	193	84	1214	2	20	9	8	3212
5:00 PM	0	352	123	66	0	41	12	389	0	3	3	3	992
5:15	0	409	79	74	0	49	39	440	0	7	3	1	1101
5:30	0	358	74	49	0	28	55	446	1	5	3	5	1024
5:45	0	364	42	55	0	23	16	367	0	3	2	0	872
HR TOTAL	0	1483	318	244	0	141	122	1642	1	18	11	9	3989
DAY TOTAL	0	3926	689	706	2	495	253	3867	6	58	25	29	10056

Site Code : 94900000
N-S Street: BLOSSOM ST/GARDEN ST
E-W Street: CAMBRIDGE ST
Weather : CLEAR

Movements by: Cars

PAGE: 1
FILE: camblsmp
GCF : 1.03
DATE: 5/16/91

Time	From West			From North			From East			From South			Vehicle
Begin	RT	THRU	LT	RT	THRU	LT	RT	THRU	LT	RT	THRU	LT	Total
3:00	0	1184	171	239	2	161	47	1011	3	20	5	12	2855
4:00	0	1259	200	223	0	193	84	1214	2	20	9	8	3212
5:00	0	1483	318	244	0	141	122	1642	1	18	11	9	3989
DAY TOTAL	0	3926	689	706	2	495	253	3867	6	58	25	29	10056

```
ite Code : 94900000                                                                                    PAGE:  1
-S Street: BLOSSOM ST/GARDEN ST                                                                        FILE: camblsmp
-W Street: CAMBRIDGE ST                                                                                GCF : 1.03
eather   : CLEAR                              Movements by: Truck/Bus                                  DATE:  5/16/91
----------------------------------------------------------------------------------------------------------------------
ime             From West              From North              From East              From South          Vehicle
egin          RT   THRU   LT         RT   THRU   LT          RT   THRU   LT         RT   THRU   LT          Total
----------------------------------------------------------------------------------------------------------------------
3:00 PM        0     1     0          0     0     0           1     2     0          0     0     1            5
3:15           0     5     0          0     0     0           0     2     0          0     0     0            7
3:30           0     1     0          1     0     1           0     2     0          0     0     0            5
3:45           0     0     0          0     0     0           0     2     0          0     0     0            2
R TOTAL         0     7     0          1     0     1           1     8     0          0     0     1           19

4:00 PM        0     0     1          0     0     0           0     1     0          0     0     0            2
4:15           0     2     0          0     0     0           0     0     0          0     0     0            2
4:30           0     0     0          0     0     0           0     1     0          0     0     0            1
4:45           0     1     0          0     0     0           0     1     0          0     0     0            2
R TOTAL         0     3     1          0     0     0           0     3     0          0     0     0            7

5:00 PM        0     0     0          0     0     0           1     1     0          0     0     0            2

------------------------------------------------------ Break --------------------------------------------------------

5:30           0     1     0          0     0     0           0     0     0          0     0     0            1
5:45           0     0     0          0     0     0           1     0     0          0     0     0            1
R TOTAL         0     1     0          0     0     0           2     1     0          0     0     0            4


----------------------------------------------------------------------------------------------------------------------

AY TOTAL        0    11     1          1     0     1           3    12     0          0     0     1           30
```

Site Code : 94900000
N-S Street: BLOSSOM ST/GARDEN ST
E-W Street: CAMBRIDGE ST
Weather : CLEAR

Movements by: Truck/Bus

PAGE: 1
FILE: camblsmp
GCF : 1.03
DATE: 5/16/91

Time	From West			From North			From East			From South			Vehicle
Begin	RT	THRU	LT	RT	THRU	LT	RT	THRU	LT	RT	THRU	LT	Total
3:00	0	7	0	1	0	1	1	8	0	0	0	1	19
4:00	0	3	1	0	0	0	0	3	0	0	0	0	7
5:00	0	1	0	0	0	0	2	1	0	0	0	0	4
DAY TOTAL	0	11	1	1	0	1	3	12	0	0	0	1	30

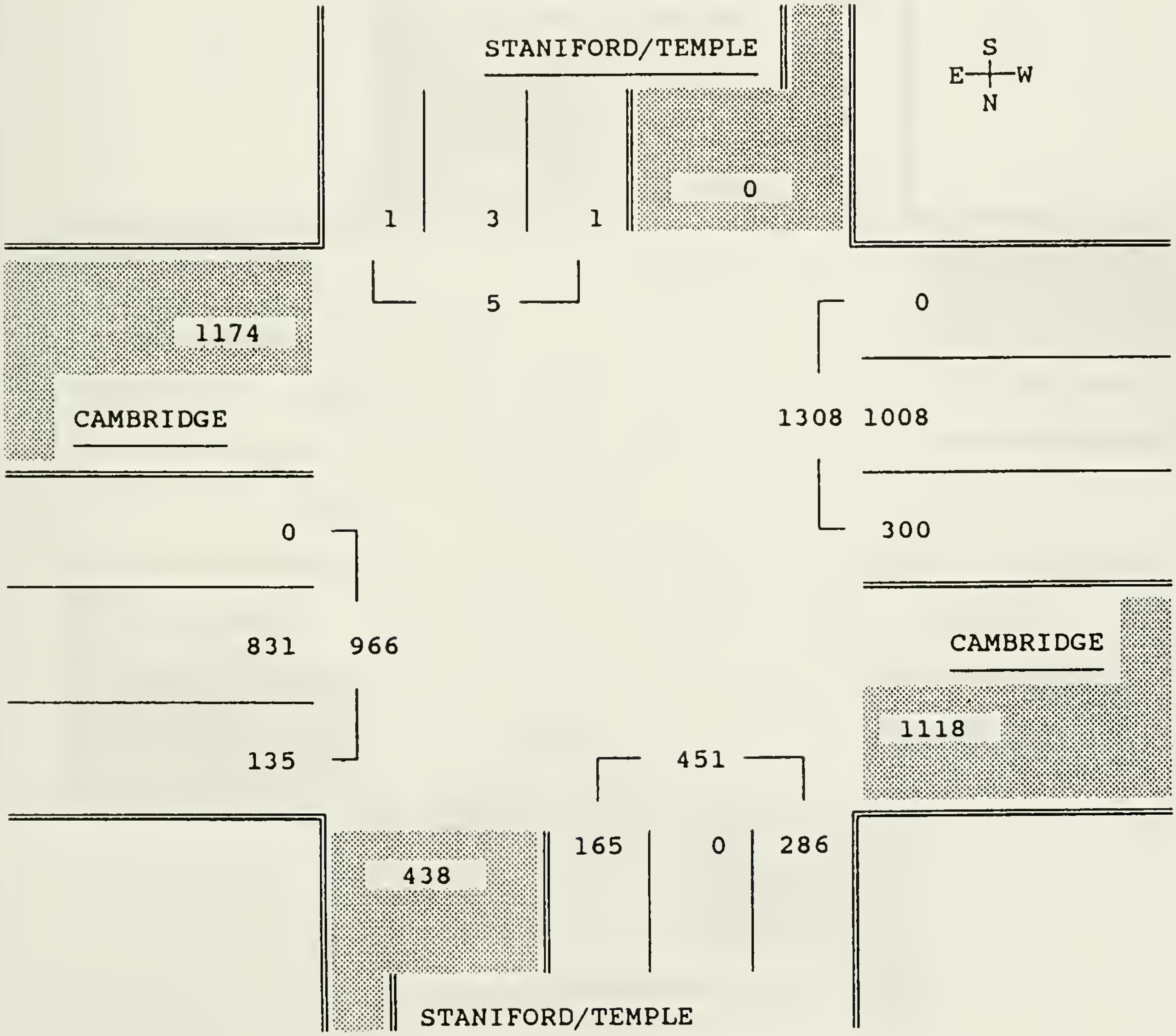
```
ite Code : 94900000                                                                      PAGE:  1
-S Street: STANIFORD/TEMPLE                                                              FILE: cmbstn
-W Street: CAMBRIDGE
eather   : CLEAR                          Sum of the Cars and Truck/Bus
                                                                                         DATE:  6/27/91
-----------------------------------------------------------------------------------------------------

                    PEAK PERIOD ANALYSIS FOR THE PERIOD:  7:00 AM -  9:00 AM

         DIRECTION     START       PEAK HR          ........ VOLUMES ........         .... PERCENTS ...
           FROM      PEAK HOUR     FACTOR        Right  Thru  Left   Total         Right  Thru  Left
         ---------------------------------------------------------------------------------------------
          South       7:15 AM       0.63            3     4     3      10            30    40    30
           West       8:00 AM       0.80            0  1008   300    1308             0    77    23
          North       8:00 AM       0.87          286     0   165     451            63     0    37
           East       8:00 AM       0.88          135   831     0     966            14    86     0

                                             Entire Intersection

          South       8:00 AM       0.42            1     3     1       5            20    60    20
           West                     0.80            0  1008   300    1308             0    77    23
          North                     0.87          286     0   165     451            63     0    37
           East                     0.88          135   831     0     966            14    86     0
```



Site Code : 94900000
N-S Street: STANIFORD/TEMPLE
E-W Street: CAMBRIDGE
Weather : CLEAR

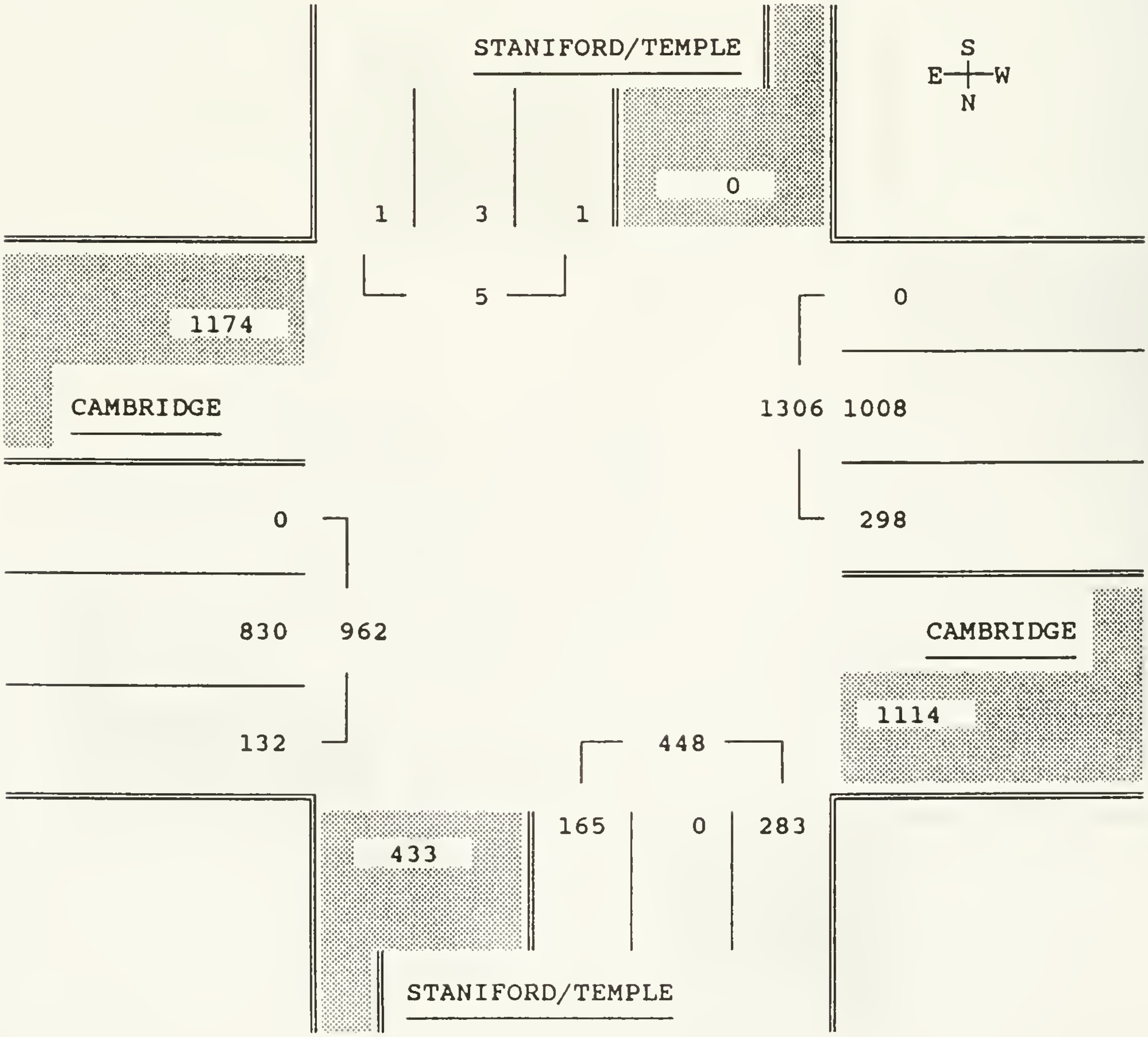
FILE: cmbstn

Movements by: Cars

DATE: 6/27/91

PEAK PERIOD ANALYSIS FOR THE PERIOD: 7:00 AM - 9:00 AM

DIRECTION FROM	START PEAK HOUR	PEAK HR FACTOR	.... VOLUMES				.... PERCENTS ...		
			Right	Thru	Left	Total	Right	Thru	Left
South	7:15 AM	0.63	3	4	3	10	30	40	30
West	8:00 AM	0.80	0	1008	298	1306	0	77	23
North	8:00 AM	0.87	283	0	165	448	63	0	37
East	8:00 AM	0.87	132	830	0	962	14	86	0
			Entire Intersection						
South	8:00 AM	0.42	1	3	1	5	20	60	20
West		0.80	0	1008	298	1306	0	77	23
North		0.87	283	0	165	448	63	0	37
East		0.87	132	830	0	962	14	86	0



Site Code : 94900000
N-S Street: STANIFORD/TEMPLE
E-W Street: CAMBRIDGE
Weather : CLEAR

PAGE: 1
FILE: cmbstn

Movements by: Truck/Bus

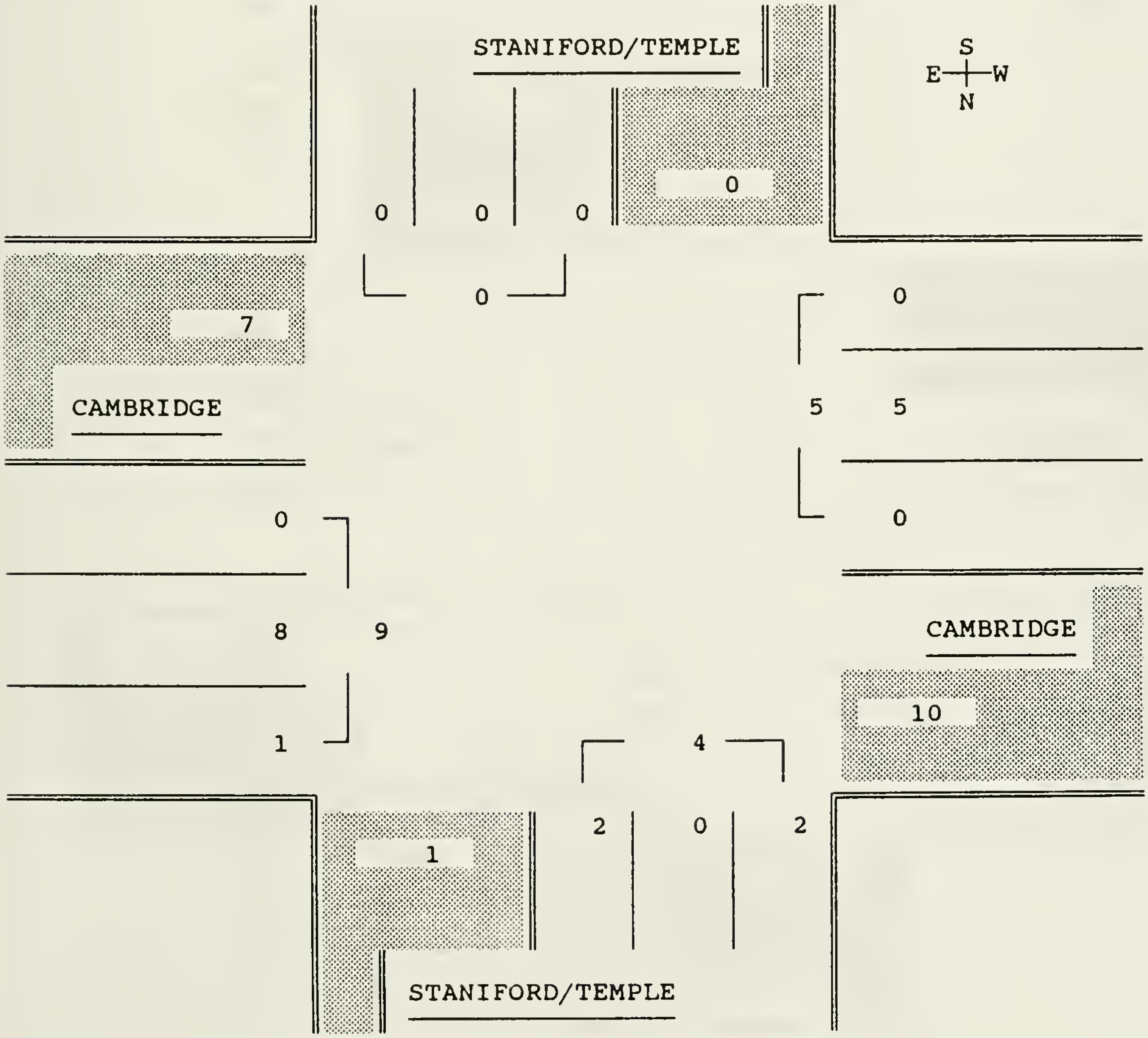
DATE: 6/27/91

PEAK PERIOD ANALYSIS FOR THE PERIOD: 7:00 AM - 9:00 AM

DIRECTION FROM	START PEAK HOUR	PEAK HR FACTOR	VOLUMES Right	VOLUMES Thru	VOLUMES Left	VOLUMES Total	PERCENTS Right	PERCENTS Thru	PERCENTS Left
South	8:00 AM	0.00	0	0	0	0	0	0	0
West	7:00 AM	0.63	0	5	0	5	0	%100	0
North	7:15 AM	0.63	3	0	2	5	60	0	40
East	7:00 AM	0.45	1	8	0	9	11	89	0

Entire Intersection

DIRECTION FROM	START PEAK HOUR	PEAK HR FACTOR	VOLUMES Right	VOLUMES Thru	VOLUMES Left	VOLUMES Total	PERCENTS Right	PERCENTS Thru	PERCENTS Left
South	7:00 AM	0.00	0	0	0	0	0	0	0
West		0.63	0	5	0	5	0	%100	0
North		0.50	2	0	2	4	50	0	50
East		0.45	1	8	0	9	11	89	0



```
Site Code : [illegible]                                                                  PAGE:  1
N-S Street: STANIFORD/TEMPLE                                                             FILE: cmbstn
E-W Street: CAMBRIDGE
Weather   : CLEAR                        Sum of the Cars and Truck/Bus
                                                                                         DATE:  6/27/91
----------------------------------------------------------------------------------------------------

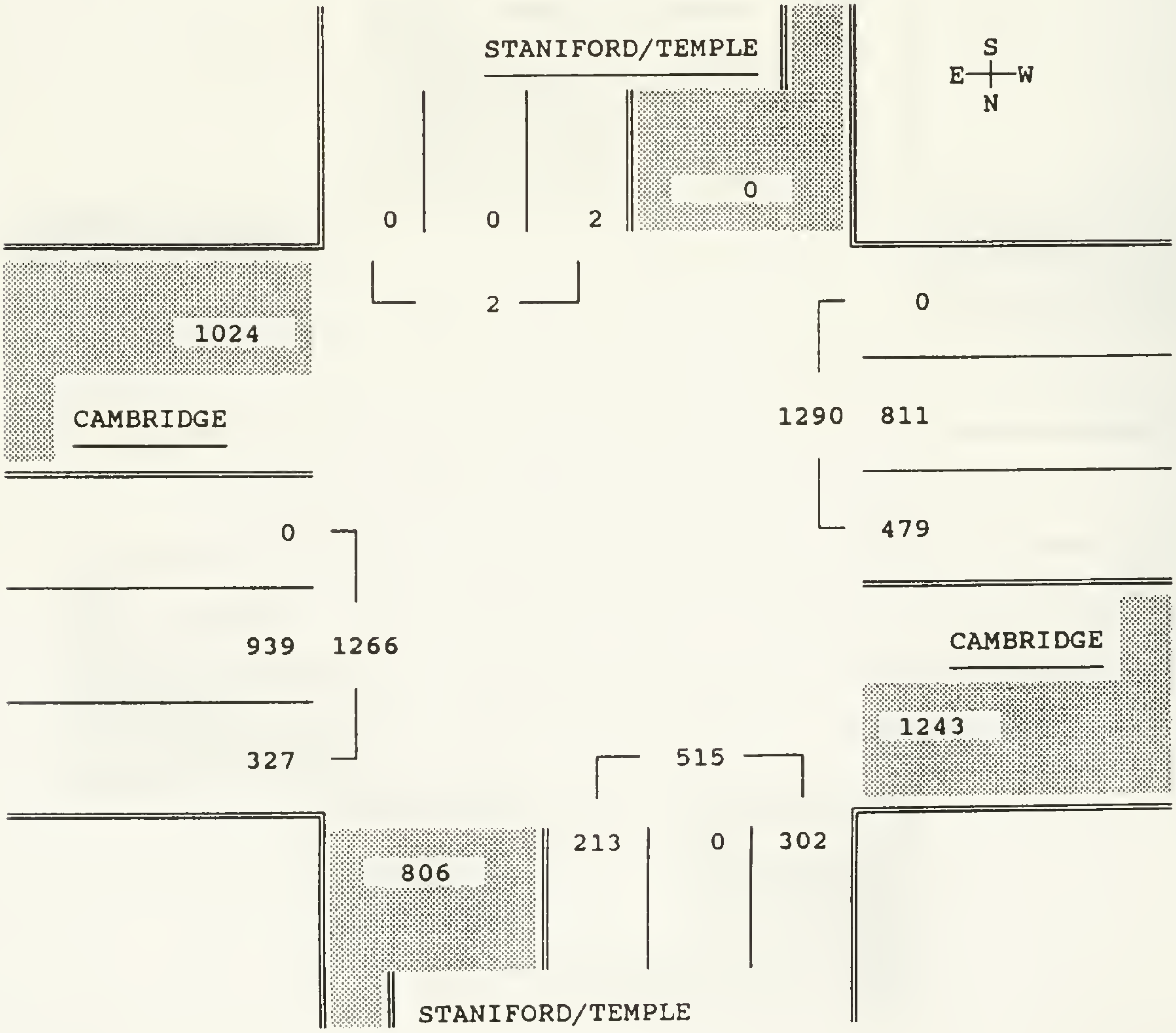
                    PEAK PERIOD ANALYSIS FOR THE PERIOD:  4:00 PM -  6:00 PM

        DIRECTION    START      PEAK HR           ........ VOLUMES ........        .... PERCENTS ...
          FROM     PEAK HOUR    FACTOR          Right  Thru  Left   Total        Right  Thru  Left
        -----------------------------------------------------------------------------------------

         South      4:00 PM      0.63              0     2     3       5            0    40    60
          West      4:15 PM      0.89              0   860   453    1313            0    65    35
         North      4:30 PM      0.91            326     0   226     552           59     0    41
          East      4:45 PM      0.91            327   939     0    1266           26    74     0

                                                  Entire Intersection

         South      4:45 PM      0.50              0     0     2       2            0     0  %100
          West                   0.87              0   811   479    1290            0    63    37
         North                   0.93            302     0   213     515           59     0    41
          East                   0.91            327   939     0    1266           26    74     0
```



```
CINCH PROGRAM VERSION DATE 4-29-1988
1985 HCM - CHAPTER 10 : UNSIGNALIZED - 3 APPROACHES (PAGE 1 of 2)
DATE:06-29-1991              TIME:09:18:49
BLOSSOM ST/O'CONNELL WAY - EXISTING AM


LAST DATASETS LOADED OR SAVED
VOLUME=BLSMAE     GEOMETRICS=BLSM
KEY: A- -B
        |
        C
GENERAL CHARACTERISTICS
POPULATION GREATER THAN 250,000: YES
CONTROLS: FROM C: STOP
PREVAILING SPEED:  35  MPH
MAIN STREET # OF LANES: 4 LANES
MAIN STREET APPROACH A - EXCLUSIVE RIGHT TURN LANE: N

MINOR STREET LANES
APPROACH: C: O'CONNELL
SHARED LEFT AND RIGHT TURN LANE: YES
LARGE RIGHT TURN RADIUS OR SHALLOW RIGHT TURN ANGLE: NO
RIGHT TURN ACCELERATION LANE ON MAJOR: NO


SIGHT DISTANCE RESTRICTIONS (in seconds)
APPROACH         A: BLOSSOM NB  B: BLOSSOM SB  C: O'CONNELL
LEFTS              0.00           0.00           0.00
THRUS              0.00           0.00           0.00
RIGHTS             0.00           0.00           0.00


APPROACH         A: BLOSSOM NB  B: BLOSSOM SB  C: O'CONNELL
                  LT   TH   RT   LT   TH   RT   LT   TH   RT
VOLUME             0  126   82   77  132    0   43    0  127
PHF                0.76           0.90           0.86
ADJ VOLUME         0  166  108   86  147    0   50    0  148
PERCENT GRADE      0.00           0.00           0.00
PERCENT CYCLES       0.00           0.00           0.00
PASSENGER CARS     99.00          99.00          %100.00
PERCENT LT TRU       0.00           0.00           0.00
PERCENT HV TRU       1.00           1.00           0.00
PASS CAR/HR        0              86             50    0  148


STEP 1 RIGHT TURNS FROM      C:O'CONNELL
CONFLICTING FLOWS                     137
CRITICAL GAPS                         5.2
CAPACITY                             1008
ACTUAL CAPACITY                      1008


STEP 2 LEFT TURNS FROM      B:BLOSSOM SB
CONFLICTING FLOWS                     274
CRITICAL GAPS                         5.1
CAPACITY                              891
CAPACITY USED                          10%
IMPEDANCE FACTOR                     0.94
ACTUAL CAPACITY                       891
```

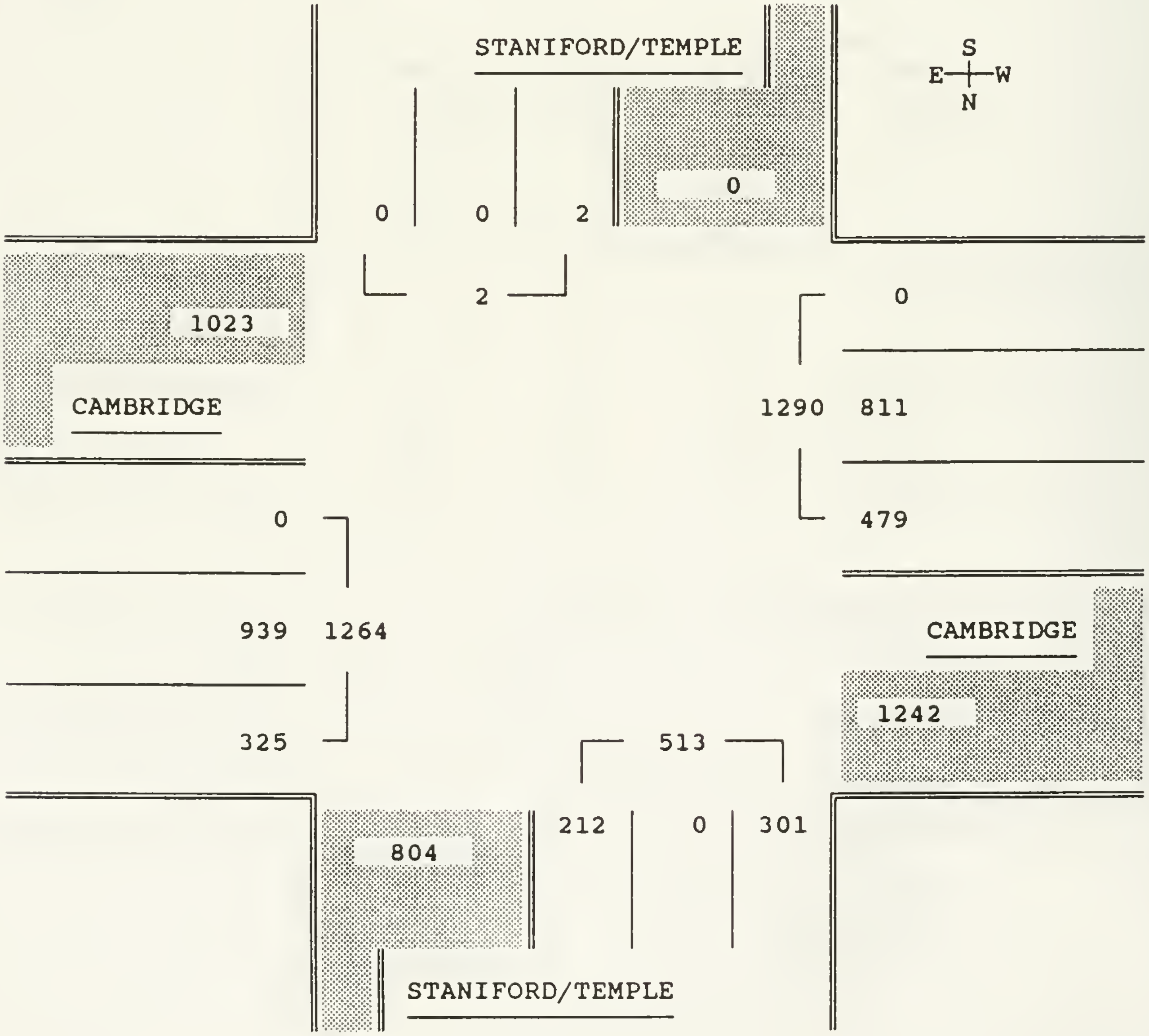
```
Site Code : 94900000                                                                          PAGE:  1
N-S Street: STANIFORD/TEMPLE                                                                  FILE: cmbstn
E-W Street: CAMBRIDGE
Weather   : CLEAR                          Movements by: Cars                                 DATE:  6/27/91
--------------------------------------------------------------------------------------------------------

                      PEAK PERIOD ANALYSIS FOR THE PERIOD:  4:00 PM -  6:00 PM

          DIRECTION     START      PEAK HR        ........ VOLUMES ........        .... PERCENTS ...
            FROM      PEAK HOUR    FACTOR        Right  Thru  Left   Total        Right  Thru  Left
          -----------------------------------------------------------------------------------------
           South       4:00 PM      0.63             0     2     3       5            0    40    60
            West       4:15 PM      0.89             0   860   451    1311            0    66    34
           North       4:30 PM      0.91           325     0   225     550           59     0    41
            East       4:45 PM      0.91           325   939     0    1264           26    74     0

                                              Entire Intersection

           South       4:45 PM      0.50             0     0     2       2            0     0  %100
            West                    0.87             0   811   479    1290            0    63    37
           North                    0.92           301     0   212     513           59     0    41
            East                    0.91           325   939     0    1264           26    74     0
```



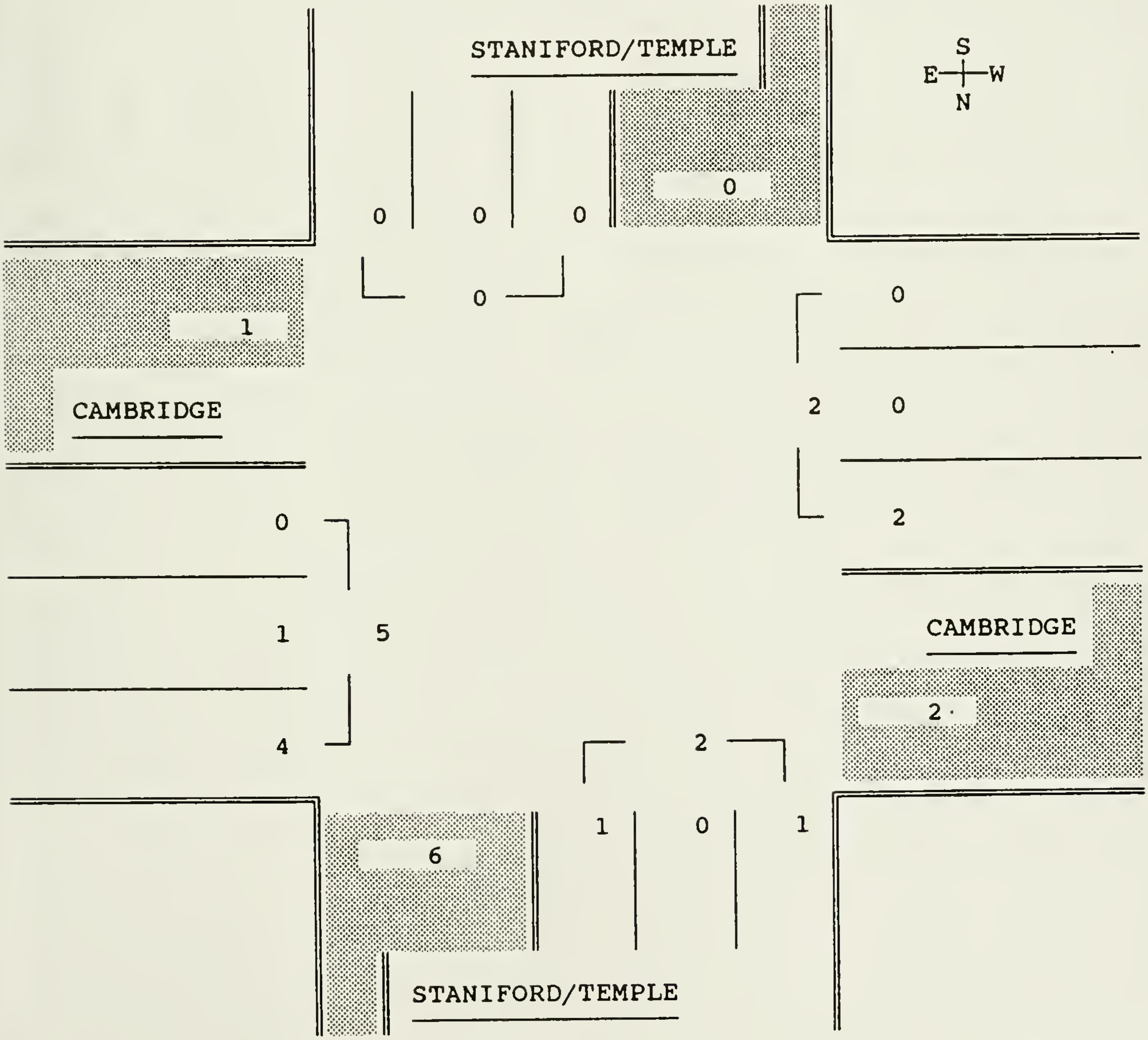
```
ite Code : 94900000                                                                        PAGE:  1
-S Street: STANIFORD/TEMPLE                                                                FILE: cmbstn
-W Street: CAMBRIDGE
eather   : CLEAR                          Movements by: Truck/Bus                           DATE:  6/27/91
-------------------------------------------------------------------------------------------------------

                         PEAK PERIOD ANALYSIS FOR THE PERIOD:  4:00 PM -  6:00 PM

         DIRECTION     START       PEAK HR        ........ VOLUMES ........        .... PERCENTS ...
            FROM     PEAK HOUR     FACTOR       Right  Thru  Left   Total       Right  Thru  Left
         -----------------------------------------------------------------------------------------
          South      4:45 PM        0.00           0     0     0      0            0     0     0
           West      4:00 PM        0.50           0     0     2      2            0     0  %100
          North      4:15 PM        0.75           2     0  ,  1      3           67     0    33
           East      4:00 PM        0.63           4     1     0      5           80    20     0

                                                 Entire Intersection

          South      4:00 PM        0.00           0     0     0      0            0     0     0
           West                     0.50           0     0     2      2            0     0  %100
          North                     0.50           1     0     1      2           50     0    50
           East                     0.63           4     1     0      5           80    20     0
```



Site Code : 94900000
N-S Street: STANIFORD/TEMPLE
E-W Street: CAMBRIDGE
Weather : CLEAR

PAGE: 1
FILE: cmbstn

Sum of the Cars and Truck/Bus

DATE: 6/27/91

Time	From South			From West			From North			From East			Vehicle
Begin	RT	THRU	LT	RT	THRU	LT	RT	THRU	LT	RT	THRU	LT	Total
7:00 AM	0	0	0	0	139	32	43	0	40	25	77	0	356
7:15	0	0	0	0	116	30	60	0	38	34	119	0	397
7:30	0	2	1	0	173	49	29	0	31	30	158	0	473
7:45	2	1	1	0	229	70	54	0	32	42	165	0	596
HR TOTAL	2	3	2	0	657	181	186	0	141	131	519	0	1822
8:00 AM	1	1	1	0	183	63	59	0	35	49	167	0	559
8:15	0	0	0	0	259	87	78	0	39	33	242	0	738
8:30	0	0	0	0	246	62	77	0	52	22	211	0	670
8:45	0	2	0	0	320	88	72	0	39	31	211	0	763
HR TOTAL	1	3	1	0	1008	300	286	0	165	135	831	0	2730
Break													
4:00 PM	0	1	0	0	163	86	54	1	44	112	123	0	584
4:15	0	1	1	0	220	94	50	0	63	90	191	0	710
4:30	0	0	1	0	214	114	82	0	69	97	216	0	793
4:45	0	0	1	0	203	98	78	0	54	103	185	0	722
HR TOTAL	0	2	3	0	800	392	264	1	230	402	715	0	2809
5:00 PM	0	0	1	0	223	147	85	0	45	91	213	0	805
5:15	0	0	0	0	160	118	81	0	58	64	264	0	745
5:30	0	0	0	0	225	116	58	0	56	69	277	0	801
Break													
DAY TOTAL	3	8	7	0	3073	1254	960	1	695	892	2819	0	9712

```
ite Code : 94900000                                                                                      PAGE:  1
I-S Street: STANIFORD/TEMPLE                                                                             FILE: cmbstn
:-W Street: CAMBRIDGE
leather   : CLEAR                                   Sum of the Cars and Truck/Bus
                                                                                                         DATE:  6/27/91
------------------------------------------------------------------------------------------------------------------------
'ime               From South               From West               From North               From East          Vehicle
legin            RT   THRU   LT          RT   THRU   LT          RT   THRU   LT          RT   THRU   LT          Total
------------------------------------------------------------------------------------------------------------------------
7:00              2     3     2           0    657   181         186     0   141         131   519     0          1822

8:00              1     3     1           0   1008   300         286     0   165         135   831     0          2730


------------------------------------------------------ Break ----------------------------------------------------------

4:00              0     2     3           0    800   392         264     1   230         402   715     0          2809

5:00              0     0     1           0    608   381         224     0   159         224   754     0          2351


------------------------------------------------------------------------------------------------------------------------

AY TOTAL          3     8     7           0   3073  1254         960     1   695         892  2819     0          9712
```

Site Code : 94900000 PAGE: 1
N-S Street: STANIFORD/TEMPLE FILE: cmbatn
E-W Street: CAMBRIDGE
Weather : CLEAR

Movements by: Cars

DATE: 6/27/91

Time	From South			From West			From North			From East			Vehicle
Begin	RT	THRU	LT	RT	THRU	LT	RT	THRU	LT	RT	THRU	LT	Total
7:00 AM	0	0	0	0	137	32	42	0	40	24	77	0	352
7:15	0	0	0	0	115	30	60	0	36	34	116	0	391
7:30	0	2	1	0	173	49	28	0	31	30	153	0	467
7:45	2	1	1	0	227	70	54	0	32	42	165	0	594
HR TOTAL	2	3	2	0	652	181	184	0	139	130	511	0	1804
8:00 AM	1	1	1	0	183	62	57	0	35	48	167	0	555
8:15	0	0	0	0	259	87	77	0	39	33	242	0	737
8:30	0	0	0	0	246	61	77	0	52	21	211	0	668
8:45	0	2	0	0	320	88	72	0	39	30	210	0	761
HR TOTAL	1	3	1	0	1008	298	283	0	165	132	830	0	2721
Break													
4:00 PM	0	1	0	0	163	86	54	1	44	111	122	0	582
4:15	0	1	1	0	220	93	49	0	63	89	191	0	707
4:30	0	0	1	0	214	113	82	0	69	97	216	0	792
4:45	0	0	1	0	203	98	78	0	53	101	185	0	719
HR TOTAL	0	2	3	0	800	390	263	1	229	398	714	0	2800
5:00 PM	0	0	1	0	223	147	84	0	45	91	213	0	804
5:15	0	0	0	0	160	118	81	0	58	64	264	0	745
5:30	0	0	0	0	225	116	58	0	56	69	277	0	801
Break													
DAY TOTAL	3	8	7	0	3068	1250	953	1	692	884	2809	0	9675

```
Site Code : 94900000                                                                    PAGE:  1
N-S Street: STANIFORD/TEMPLE                                                            FILE: cmbstn
E-W Street: CAMBRIDGE
Weather   : CLEAR                              Movements by: Cars                       DATE:  6/27/91
------------------------------------------------------------------------------------------------------
Time              From South            From West             From North            From East        Vehicle
Begin           RT   THRU   LT       RT   THRU    LT       RT   THRU   LT        RT   THRU   LT      Total
------------------------------------------------------------------------------------------------------
 7:00            2     3     2        0    652   181       184     0   139       130   511    0      1804

 8:00            1     3     1        0   1008   298       283     0   165       132   830    0      2721


---------------------------------------------- Break ,-------------------------------------------------

 4:00            0     2     3        0    800   390       263     1   229       398   714    0      2800

 5:00            0     0     1        0    608   381       223     0   159       224   754    0      2350


------------------------------------------------------------------------------------------------------

DAY TOTAL         3     8     7        0   3068  1250       953     1   692       884  2809    0      9675
```

Site Code : 94900000
N-S Street: STANIFORD/TEMPLE
E-W Street: CAMBRIDGE
Weather : CLEAR

Movements by: Truck/Bus

PAGE: 1
FILE: cmbstn
DATE: 6/27/91

Time	From South			From West			From North			From East			Vehicle
Begin	RT	THRU	LT	RT	THRU	LT	RT	THRU	LT	RT	THRU	LT	Total
7:00 AM	0	0	0	0	2	0	1	0	0	1	0	0	4
7:15	0	0	0	0	1	0	0	0	2	0	3	0	6
7:30	0	0	0	0	0	0	1	0	0	0	5	0	6
7:45	0	0	0	0	2	0	0	0	0	0	0	0	2
HR TOTAL	0	0	0	0	5	0	2	0	2	1	8	0	18
8:00 AM	0	0	0	0	0	1	2	0	0	1	0	0	4
8:15	0	0	0	0	0	0	1	0	0	0	0	0	1
8:30	0	0	0	0	0	1	0	0	0	1	0	0	2
8:45	0	0	0	0	0	0	0	0	0	1	1	0	2
HR TOTAL	0	0	0	0	0	2	3	0	0	3	1	0	9
Break													
4:00 PM	0	0	0	0	0	0	0	0	0	1	1	0	2
4:15	0	0	0	0	0	1	1	0	0	1	0	0	3
4:30	0	0	0	0	0	1	0	0	0	0	0	0	1
4:45	0	0	0	0	0	0	0	0	1	2	0	0	3
HR TOTAL	0	0	0	0	0	2	1	0	1	4	1	0	9
5:00 PM	0	0	0	0	0	0	1	0	0	0	0	0	1
Break													
DAY TOTAL	0	0	0	0	5	4	7	0	3	8	10	0	37

```
Site Code : 94900000                                                                          PAGE:  1
N-S Street: STANIFORD/TEMPLE                                                                  FILE: cmbstn
E-W Street: CAMBRIDGE
Weather   : CLEAR                          Movements by: Truck/Bus                            DATE:  6/27/91
-------------------------------------------------------------------------------------------------------------
Time              From South            From West             From North            From East        Vehicle
Begin           RT   THRU   LT        RT   THRU   LT        RT   THRU   LT        RT   THRU   LT       Total
-------------------------------------------------------------------------------------------------------------
 7:00            0     0     0         0     5     0         2     0     2         1     8     0        18

 8:00            0     0     0         0     0     2         3     0     0         3     1     0         9


------------------------------------------------- Break ,---------------------------------------------------

 4:00            0     0     0         0     0     2         1     0     1         4     1     0         9

 5:00            0     0     0         0     0     0         1     0     0         0     0     0         1


-------------------------------------------------------------------------------------------------------------

DAY TOTAL         0     0     0         0     5     4         7     0     3         8    10     0        37
```

Appendix B2

Capacity Calculations

```
CINCH PROGRAM VERSION DATE 4-29-1988
1985 HCM - CHAPTER 9: SIGNALIZED - OPERATIONAL ANALYSIS
CAMBRIDGE STREET/BLOSSOM STREET
EXISTING AM
date:08-05-1991           time:02:51:03
LAST DATA SET NAMES LOADED OR SAVED
VOLUME=           GEOMETRICS=           SIGNAL=
LOCATED IN CBD:Y
VOLUME & GEOMETRICS
        VOLUMES      # OF LANES     LANE WIDTH     CROSS
DIR  LT   TH   RT    LT TH RT      LT   TH   RT     WALK
EB   98 1317    0     1  2  0    12.0 11.0  0.0      0
WB    0  736   60     0  2  0     0.0 12.0  0.0      0
NB   15    4   11     0  1  0     0.0 12.0  0.0      0
SB   92    0  167     1  0  1    12.0  0.0 12.0      0

TRAFFIC & ROADWAY CONDITIONS
                 ADJ PARK             PEDESTRIANS       ARR
DIR GRADE %HV   Y/N MOVES BUSES  PHF CROSS BUT MIN TIME TYPE
EB  0.0%  2.0%        0     0   .980    0        7.0   4
WB  0.0%  7.0%        0     0   .970    0        7.0   4
NB  0.0%  0.0%        0     0   .750    0        7.0   3
SB  0.0%  7.0%        0     0   .880    0        7.0   3

PHASINGS
    EASTBOUND   WESTBOUND   NORTHBOUND  SOUTHBOUND GREEN  Y+R PRE/ACT
    l  t  r  p  l  t  r  p  l  t  r  p  l  t  r  p
 1     *  *           *  *                           54.6   4    A
 2  *  *                                      *      12.9   4    A
 3                          *  *  *     *     *      10.5   4    A

CYCLE=  90.0

VOLUME ADJUSTMENT WORKSHEET
PART 1 (MOVEMENT ADJUSTMENTS)
DIR  LTV  THV  RTV   PHF  LTFR THFR RTFR
EB    98 1317    0  .980   100 1344    0
WB     0  736   60  .970     0  759   62
NB    15    4   11  .750    20    5   15
SB    92    0  167  .880   105    0  190

PART 2 (LANE GROUP ADJUSTMENTS)
DIR LN GROUP  FLOW N   LU    v  Plt  Prt
EB  LT         100 1 1.00  100 1.00 0.00
EB  TH        1344 2 1.05 1411 0.00 0.00
WB  TH-RT      821 2 1.05  862 0.00 0.08
NB  LT-TH-RT    40 1 1.00   40 0.50 0.37
SB  LT         105 1 1.00  105 1.00 0.00
SB  RT         190 1 1.00  190 0.00 1.00

PART 3 (OPPOSING VOLUME ADJUSTMENTS)
LEFT TURN                 OPPOSING APPROACH
BEING OPPOSED        VOLUMES       % OPPOSING LEFT TURN    # LANES      OPPOSING
                   LT   TH   RT        LT   TH   RT        LT  TH  RT    VOLUME
EASTBOUND           0  759   62         0    0    0         0   2   0       0
```

```
NORTHBOUND       105    0  190         100     0     0          1   0   1          0
SOUTHBOUND        20    5   15         100   100   100          0   1   0         20

SATURATION FLOW ADJUSTMENT WORKSHEET
DIR LN GROUP   IDEAL N  Fwid   Fhv   Fgr Fpark  Fbus Farea   Frt   Flt    s
EB  LT          1800  1 1.000 0.990 1.000 1.000 1.000 0.900 1.000 0.950 1524
EB  TH          1800  2 0.967 0.990 1.000 1.000 1.000 0.900 1.000 1.000 3101
WB  TH-RT       1800  2 1.000 0.966 1.000 1.000 1.000 0.900 0.989 1.000 3095
NB  LT-TH-RT    1800  1 1.000 1.000 1.000 1.000 1.000 0.900 0.851 0.833 1147
SB  LT          1800  1 1.000 0.966 1.000 1.000 1.000 0.900 1.000 1.000 1565
SB  RT          1800  1 1.000 0.966 1.000 1.000 1.000 0.900 0.850 1.000 1330

SUPPLEMENTAL WORKSHEET FOR LEFT-TURN ADJUSTMENT FACTOR FLT
INPUT VARIABLES
DIR  C   G  N   Va   Vm  Vlt  Plt No   Vo Plto
SB  90  10  1  105  190  105 1.00  1   20 0.50
CALCULATIONS
DIR Sop    Yo     Gu    Fs    Pl     Gq    Pt     Gf       El    Fm   Flt
SB 1447 0.014  9.382 0.863 1.000  1.114 0.000  0.000    1.304 1.000 1.000

CAPACITY ANALYSIS WORKSHEET
DIR LN GROUP     v    s  v/s  g/C    c  v/c  CRITICAL
EB  LT         100 1524 0.07 0.14  218 0.46
EB  TH        1411 3101 0.46 0.79 2464 0.57      *
WB  TH-RT      862 3095 0.28 0.61 1879 0.46
NB  LT-TH-RT    40 1147 0.03 0.12  134 0.30
SB  LT         105 1565 0.07 0.12  183 0.57      *
SB  RT         190 1330 0.14 0.30  405 0.47

CYCLE= 90.0  LOST= 8.0  SUM V/S CRIT= 0.52 TOTAL V/C= 0.57

LEVEL OF SERVICE WORKSHEET
DIR LN GROUP  v/c  g/C    C     d1    c      d2   PF   Delay LOS Avg Q  95% Q
EB  LT       0.46 0.14  90.0  26.88  218    1.10 1.00   27.98  D   2.1
EB  TH       0.57 0.79  90.0   2.65 2464    0.25 0.62    1.80  A   6.9
WB  TH-RT    0.46 0.61  90.0   7.32 1879    0.13 0.62    4.62  A   8.1
NB  LT-TH-RT 0.30 0.12  90.0  27.65  134    0.39 0.85   23.83  C   0.9
SB  LT       0.57 0.12  90.0  28.60  183    3.13 0.85   26.97  D   2.3
SB  RT       0.47 0.30  90.0  19.32  405    0.65 0.85   16.97  C   3.3

DIR Delay LOS
EB   3.53  A
WB   4.62  A
NB  23.83  C
SB  20.52  C
INTERSECTION DELAY =   6.02 INTERSECTION LOS=B

THE CYCLE LENGTH WITHIN THE BOUNDS OF  90  TO  90 SECONDS
WHICH MINIMIZES CRITICAL MOVEMENT DELAY IS  90.0 SECONDS

FOR A V/C RATIO OF .95 THE CYCLE SHOULD BE  17.8 SECONDS
THE EXISTING TIMING IS OPTIMAL
```

```
CINCH PROGRAM VERSION DATE 4-29-1988
1985 HCM - CHAPTER 9: SIGNALIZED - OPERATIONAL ANALYSIS
CAMBRIDGE STREET/BLOSSOM STREET
EXISTING PM
date:08-05-1991            time:02:54:21
LAST DATA SET NAMES LOADED OR SAVED
VOLUME=            GEOMETRICS=           SIGNAL=
LOCATED IN CBD:Y
VOLUME & GEOMETRICS
        VOLUMES      # OF LANES     LANE WIDTH     CROSS
DIR  LT   TH   RT    LT TH RT      LT   TH   RT    WALK
EB  318 1484    0     1  2  0    12.0 11.0  0.0     0
WB    0 1644  125     0  2  1     0.0 12.0 12.0     0
NB    9   11   18     0  1  0     0.0 12.0  0.0     0
SB  141    0  244     1  0  1    12.0  0.0 12.0     0

TRAFFIC & ROADWAY CONDITIONS
                 ADJ PARK             PEDESTRIANS        ARR
DIR GRADE %HV   Y/N MOVES BUSES  PHF CROSS BUT MIN TIME TYPE
EB  0.0%  2.0%         0    0   .920   0          7.0    4
WB  0.0%  7.0%         0    0   .880   0          7.0    4
NB  0.0%  0.0%         0    0   .730   0          7.0    3
SB  0.0%  7.0%         0    0   .920   0          7.0    3

PHASINGS
    EASTBOUND   WESTBOUND   NORTHBOUND  SOUTHBOUND GREEN  Y+R PRE/ACT
    l  t  r  p  l  t  r  p  l  t  r  p  l  t  r  p
 1     *  *        *  *                               58.0  4    A
 2  *  *                                      *       21.0  4    A
 3                          *  *  *     *     *        9.1  4    A

CYCLE= 100.0

VOLUME ADJUSTMENT WORKSHEET
PART 1 (MOVEMENT ADJUSTMENTS)
DIR  LTV  THV  RTV   PHF  LTFR THFR RTFR
EB   318 1484    0  .920   346 1613    0
WB     0 1644  125  .880     0 1868  142
NB     9   11   18  .730    12   15   25
SB   141    0  244  .920   153    0  265

PART 2 (LANE GROUP ADJUSTMENTS)
DIR LN GROUP   FLOW N   LU     v  Plt  Prt
EB  LT          346 1 1.00  346 1.00 0.00
EB  TH         1613 2 1.05 1694 0.00 0.00
WB  TH         1868 2 1.05 1962 0.00 0.00
WB  RT          142 1 1.00  142 0.00 1.00
NB  LT-TH-RT     52 1 1.00   52 0.24 0.47
SB  LT          153 1 1.00  153 1.00 0.00
SB  RT          265 1 1.00  265 0.00 1.00

PART 3 (OPPOSING VOLUME ADJUSTMENTS)
LEFT TURN                OPPOSING APPROACH
BEING OPPOSED       VOLUMES      % OPPOSING LEFT TURN    # LANES      OPPOSING
                 LT   TH   RT        LT    TH    RT      LT  TH  RT     VOLUME
EASTBOUND         0 1868  142         0     0     0       0   2   1        0
NORTHBOUND      153    0  265       100     0     0       1   0   1        0
SOUTHBOUND       12   15   25       100   100   100       0   1   0       40
```

```
SATURATION FLOW ADJUSTMENT WORKSHEET
DIR LN GROUP   IDEAL N  Fwid   Fhv    Fgr Fpark  Fbus Farea   Frt   Flt     s
EB  LT          1800  1 1.000 0.990 1.000 1.000 1.000 0.900 1.000 0.950 1524
EB  TH          1800  2 0.967 0.990 1.000 1.000 1.000 0.900 1.000 1.000 3101
WB  TH          1800  2 1.000 0.966 1.000 1.000 1.000 0.900 1.000 1.000 3130
WB  RT          1800  1 1.000 0.966 1.000 1.000 1.000 0.900 0.850 1.000 1330
NB  LT-TH-RT    1800  1 1.000 1.000 1.000 1.000 1.000 0.900 0.836 0.868 1176
SB  LT          1800  1 1.000 0.966 1.000 1.000 1.000 0.900 1.000 1.000 1565
SB  RT          1800  1 1.000 0.966 1.000 1.000 1.000 0.900 0.850 1.000 1330

SUPPLEMENTAL WORKSHEET FOR LEFT-TURN ADJUSTMENT FACTOR FLT
INPUT VARIABLES
DIR  C    G  N    Va    Vm   Vlt  Plt No    Vo Plto
SB 100    9  1   153   265   153 1.00  1    40 0.24
CALCULATIONS
DIR Sop     Yo      Gu      Fs     Pl      Gq     Pt      Gf        El     Fm   Flt
SB 1581 0.025  6.712 0.850 1.000  2.345 0.000  0.000     1.323 1.000 1.000

CAPACITY ANALYSIS WORKSHEET
DIR LN GROUP     v     s  v/s  g/C     c  v/c  CRITICAL
EB  LT         346  1524 0.23 0.21   320 1.08      *
EB  TH        1694  3101 0.55 0.83  2572 0.66
WB  TH        1962  3130 0.63 0.58  1814 1.08      *
WB  RT         142  1330 0.11 0.58   771 0.18
NB  LT-TH-RT    52  1176 0.04 0.09   106 0.49
SB  LT         153  1565 0.10 0.09   142 1.08      *
SB  RT         265  1330 0.20 0.34   453 0.59

CYCLE=100.0  LOST=12.0  SUM V/S CRIT= 0.95 TOTAL V/C= 1.08

LEVEL OF SERVICE WORKSHEET
DIR LN GROUP  v/c  g/C    C      d1     c      d2    PF    Delay LOS Avg Q  95% Q
EB  LT        1.08 0.21 100.0  30.69   320   66.21 1.00   96.90  F  13.1
EB  TH        0.66 0.83 100.0   2.44  2572    0.45 0.65    1.87  A   7.6
WB  TH        1.08 0.58 100.0  17.99  1814   42.07 0.80   48.20  E  35.9
WB  RT        0.18 0.58 100.0   7.52   771    0.01 0.62    4.67  A   1.7
NB  LT-TH-RT  0.49 0.09 100.0  32.88   106    2.79 0.85  [illegible]
SB  LT        1.08 0.09 100.0  34.84   142   88.91 0.85  105.19  F   6.4
SB  RT        0.59 0.34 100.0  20.65   453    1.44 0.85   18.78  C   4.9

DIR Delay LOS
EB  17.98  C
WB  45.26  E
NB  30.32  D
SB  50.42  E
INTERSECTION DELAY = 33.50 INTERSECTION LOS=D

THE CYCLE LENGTH WITHIN THE BOUNDS OF  100  TO  100 SECONDS
WHICH MINIMIZES CRITICAL MOVEMENT DELAY IS 100.0 SECONDS

THE V/C RATIO CAN'T BE .95 FOR THE GIVEN CONDITIONS
THE EXISTING TIMING IS OPTIMAL
```

```
CINCH PROGRAM VERSION DATE 4-29-1988
1985 HCM - CHAPTER 10 : UNSIGNALIZED - 3 APPROACHES (PAGE 1 of 2)
DATE:08-05-1991             TIME:06:19:46
BLOSSOM ST/O'CONNELL WAY - EXISTING AM


LAST DATASETS LOADED OR SAVED
VOLUME=            GEOMETRICS=
KEY: A- -B
       |
       C
GENERAL CHARACTERISTICS
POPULATION GREATER THAN 250,000: YES
CONTROLS: FROM C: STOP
PREVAILING SPEED:  35  MPH
MAIN STREET # OF LANES: 4 LANES
MAIN STREET APPROACH A - EXCLUSIVE RIGHT TURN LANE: N

MINOR STREET LANES
APPROACH: C: O'CONNELL
SHARED LEFT AND RIGHT TURN LANE: YES
LARGE RIGHT TURN RADIUS OR SHALLOW RIGHT TURN ANGLE: NO
RIGHT TURN ACCELERATION LANE ON MAJOR: NO


SIGHT DISTANCE RESTRICTIONS (in seconds)
APPROACH         A: BLOSSOM NB  B: BLOSSOM SB  C: O'CONNELL
LEFTS              0.00           0.00           0.00
THRUS              0.00           0.00           0.00
RIGHTS             0.00           0.00           0.00


APPROACH         A: BLOSSOM NB  B: BLOSSOM SB  C: O'CONNELL
                 LT   TH   RT   LT   TH   RT   LT   TH   RT
VOLUME            0  126   82   77  132    0   43    0  127
PHF               0.76          0.90           0.86
ADJ VOLUME        0  166  108   86  147    0   50    0  148
PERCENT GRADE     0.00          0.00           0.00
PERCENT CYCLES      0.00          0.00           0.00
PASSENGER CARS     99.00         99.00          %100.00
PERCENT LT TRU      0.00          0.00           0.00
PERCENT HV TRU      1.00          1.00           0.00
PASS CAR/HR       0             86             50    0  148


STEP 1 RIGHT TURNS FROM     C:O'CONNELL
CONFLICTING FLOWS                      137
CRITICAL GAPS                          5.2
CAPACITY                              1008
ACTUAL CAPACITY                       1008


STEP 2 LEFT TURNS FROM     B:BLOSSOM SB
CONFLICTING FLOWS                      274
```

```
CRITICAL GAPS                       5.1
CAPACITY                            891
CAPACITY USED                        10%
IMPEDANCE FACTOR                   0.94
ACTUAL CAPACITY                     891
```

```
1985 HCM - CHAPTER 10 : UNSIGNALIZED - 3 APPROACHES (PAGE 2 of 2)
DATE:08-05-1991          TIME:06:19:46
BLOSSOM ST/O'CONNELL WAY - EXISTING AM


STEP 3 LEFT TURNS FROM     C:O'CONNELL
CONFLICTING FLOWS                     452
CRITICAL GAPS                         6.8
CAPACITY                              487
ACTUAL CAPACITY                       458


                         SUMMARY OF LEVEL OF SERVICE BY MOVEMENT
MOVEMENT                    DEMAND    CAPACITY  RESERVE   LOS  AVG DEL(SEC) AVG QUEUE

LT FROM B:                    86         891       804     A      4.48          0.11

ALL MOVES FROM C:            198         774       576     A      6.25          0.34
```

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CINCH PROGRAM VERSION DATE 4-29-1988
1985 HCM - CHAPTER 10 : UNSIGNALIZED - 3 APPROACHES (PAGE 1 of 2)
DATE:06-29-1991              TIME:09:20:04
BLOSSOM ST/O'CONNELL WAY - EXISTING PM


LAST DATASETS LOADED OR SAVED
VOLUME=BLSMPE     GEOMETRICS=BLSM
KEY: A-  -B
       |
       C
GENERAL CHARACTERISTICS
POPULATION GREATER THAN 250,000: YES
CONTROLS: FROM C: STOP
PREVAILING SPEED:  35  MPH
MAIN STREET # OF LANES: 4 LANES
MAIN STREET APPROACH A - EXCLUSIVE RIGHT TURN LANE: N

MINOR STREET LANES
APPROACH: C: O'CONNELL
SHARED LEFT AND RIGHT TURN LANE: YES
LARGE RIGHT TURN RADIUS OR SHALLOW RIGHT TURN ANGLE: NO
RIGHT TURN ACCELERATION LANE ON MAJOR: NO


SIGHT DISTANCE RESTRICTIONS (in seconds)
APPROACH        A: BLOSSOM NB  B: BLOSSOM SB  C: O'CONNELL
LEFTS             0.00           0.00           0.00
THRUS             0.00           0.00           0.00
RIGHTS            0.00           0.00           0.00


APPROACH        A: BLOSSOM NB  B: BLOSSOM SB  C: O'CONNELL
                 LT   TH   RT   LT   TH   RT   LT   TH   RT
VOLUME            0  272  130   82  212    0   90    0   84
PHF               0.93           0.95           0.80
ADJ VOLUME        0  292  140   86  223    0  113    0  105
PERCENT GRADE     0.00           0.00           0.00
PERCENT CYCLES      0.00           0.00           0.00
PASSENGER CARS     %100.00        %100.00        %100.00
PERCENT LT TRU      0.00           0.00           0.00
PERCENT HV TRU      0.00           0.00           0.00
PASS CAR/HR       0             86             113    0  105


STEP 1 RIGHT TURNS FROM     C:O'CONNELL
CONFLICTING FLOWS                      216
CRITICAL GAPS                          5.2
CAPACITY                               927
ACTUAL CAPACITY                        927


STEP 2 LEFT TURNS FROM     B:BLOSSOM SB
CONFLICTING FLOWS                      432
CRITICAL GAPS                          5.1
CAPACITY                               750
CAPACITY USED                           12%
IMPEDANCE FACTOR                      0.93
ACTUAL CAPACITY                        750
```

```
1985 HCM - CHAPTER 10 : UNSIGNALIZED - 3 APPROACHES (PAGE 2 of 2)
DATE:06-29-1991           TIME:09:20:04
BLOSSOM ST/O'CONNELL WAY - EXISTING PM


STEP 3 LEFT TURNS FROM     C:O'CONNELL
CONFLICTING FLOWS                     672
CRITICAL GAPS                         6.8
CAPACITY                              349
ACTUAL CAPACITY                       324


                         SUMMARY OF LEVEL OF SERVICE BY MOVEMENT
MOVEMENT                   DEMAND    CAPACITY  RESERVE   LOS  AVG DEL(SEC) AVG QUEUE

LT FROM B:                    86        750       664     A      5.43         0.13

ALL MOVES FROM C:            218        472       254     C     14.15         0.86
```

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CINCH PROGRAM VERSION DATE 4-29-1988
1985 HCM - CHAPTER 10: UNSIGNALIZED - 4 APPROACHES (PAGE 1 OF 2)
DATE:06-29-1991              TIME:09:21:47
STANIFORD ST/O'CONNELL WAY - EXISTING AM


LAST DATASETS LOADED OR SAVED
VOLUME=STNFRDAE   GEOMETRICS=STNFRD
KEY:   D
       |
     A- -B
       |
       C
GENERAL CHARACTERISTICS
POPULATION GREATER THAN 250,000: YES
CONTROLS: FROM C: STOP
          FROM D: YIELD
PREVAILING SPEED:  35  MPH
MAIN STREET # OF LANES: 4 LANES
MAIN STREET APPROACH A - EXCLUSIVE RIGHT TURN LANE: NO
MAIN STREET APPROACH B - EXCLUSIVE RIGHT TURN LANE: NO

MINOR STREET LANES

APPROACH: C: O'CONNELL WAY
EXCLUSIVE LEFT TURN LANES: NO
EXCLUSIVE RIGHT TURN LANES: NO
LARGE RIGHT TURN RADIUS OR SHALLOW RIGHT TURN ANGLE: NO
RIGHT TURN ACCELERATION LANE ON MAJOR: NO

APPROACH: D:
EXCLUSIVE LEFT TURN LANES: NO
EXCLUSIVE RIGHT TURN LANES: NO
LARGE RIGHT TURN RADIUS OR SHALLOW RIGHT TURN ANGLE: NO
RIGHT TURN ACCELERATION LANE ON MAJOR: NO

SIGHT DISTANCE RESTRICTIONS (IN SECONDS)
APPROACH        A: STANIFORD N B: STANIFORD S C: O'CONNELL W D:
LEFTS             0.00           0.00           0.00           0.00
THRUS             0.00           0.00           0.00           0.00
RIGHTS            0.00           0.00           0.00           0.00


APPROACH        A: STANIFORD N B: STANIFORD S C: O'CONNELL W D:
                LT   TH   RT   LT   TH   RT   LT   TH   RT   LT   TH   RT
VOLUME          59  400    1    8  356  143   96    0   20    0    0    0
PHF               0.88           0.94           0.85           1.00
ADJ VOLUME      67  455    1    9  379  152  113    0   24    0    0    0
PERCENT GRADE     0.00           0.00           0.00
PERCENT CYCLES      0.00           0.00           0.00           0.00
PASSENGER CARS     98.00          97.00          96.00           0.00
PERCENT LT TRU      0.00           0.00           0.00           0.00
PERCENT HV TRU      2.00           3.00           4.00           0.00
PASS CAR/HR     68             9              117    0   24    0    0    0


STEP 1 RIGHT TURNS FROM      C:O'CONNELL WAY          D:
CONFLICTING FLOWS                       228                 265
CRITICAL GAPS                           5.2                 4.6
```

CAPACITY	916	1007
CAPACITY USED	3%	0%
IMPEDANCE FACTOR	0.99	1.00
ACTUAL CAPACITY	916	1007

```
1985 HCM - CHAPTER 10: UNSIGNALIZED - 4 APPROACHES (PAGE 2 OF 2)
DATE:06-29-1991           TIME:09:21:47
STANIFORD ST/O'CONNELL WAY - EXISTING AM

STEP 2 LEFT TURNS FROM     B:STANIFORD SB          A:STANIFORD NB
CONFLICTING FLOWS                     456                 531
CRITICAL GAPS                         5.6                 5.6
CAPACITY                              643                 586
CAPACITY USED                          1%                 12%
IMPEDANCE FACTOR                     0.99                0.93
ACTUAL CAPACITY                       643                 586


STEP 3 THRU MOVES FROM     C:O'CONNELL WAY         D:
CONFLICTING FLOWS                    1062                 986
CRITICAL GAPS                         6.8                 6.2
CAPACITY                              186                 260
CAPACITY USED                          0%                  0%
IMPEDANCE FACTOR                     1.00                1.00
ACTUAL CAPACITY                       171                 239


STEP 4 LEFT TURNS FROM     C:O'CONNELL WAY         D:
CONFLICTING FLOWS                    1062                1010
CRITICAL GAPS                         7.3                 6.7
CAPACITY                              155                 210
ACTUAL CAPACITY                       143                 191


                    SUMMARY OF LEVEL OF SERVICE BY MOVEMENT
MOVEMENT                DEMAND    CAPACITY  RESERVE   LOS  AVG DEL(SEC) AVG QUEUE

LT FROM A:                  68        586       518     A      6.95          0.13
LT FROM B:                   9        643       634     A      5.67          0.01

ALL MOVES FROM C:          142        167        25     E    142.42          5.62
```

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CINCH PROGRAM VERSION DATE 4-29-1988
1985 HCM - CHAPTER 10: UNSIGNALIZED - 4 APPROACHES (PAGE 1 OF 2)
DATE:06-29-1991           TIME:09:23:30
STANIFORD/O'CONNELL - EXISTING PM


LAST DATASETS LOADED OR SAVED
VOLUME=STNFDPE    GEOMETRICS=STNFRD
KEY:   D
       |
     A- -B
       |
       C
GENERAL CHARACTERISTICS
POPULATION GREATER THAN 250,000: YES
CONTROLS: FROM C: STOP
          FROM D: YIELD
PREVAILING SPEED:  35  MPH
MAIN STREET # OF LANES: 4 LANES
MAIN STREET APPROACH A - EXCLUSIVE RIGHT TURN LANE: NO
MAIN STREET APPROACH B - EXCLUSIVE RIGHT TURN LANE: NO

MINOR STREET LANES

APPROACH: C: O'CONNELL WAY
EXCLUSIVE LEFT TURN LANES: NO
EXCLUSIVE RIGHT TURN LANES: NO
LARGE RIGHT TURN RADIUS OR SHALLOW RIGHT TURN ANGLE: NO
RIGHT TURN ACCELERATION LANE ON MAJOR: NO

APPROACH: D:
EXCLUSIVE LEFT TURN LANES: NO
EXCLUSIVE RIGHT TURN LANES: NO
LARGE RIGHT TURN RADIUS OR SHALLOW RIGHT TURN ANGLE: NO
RIGHT TURN ACCELERATION LANE ON MAJOR: NO

SIGHT DISTANCE RESTRICTIONS (in seconds)
APPROACH        A: STANIFORD N B: STANIFORD S C: O'CONNELL W D:
LEFTS             0.00           0.00           0.00           0.00
THRUS             0.00           0.00           0.00           0.00
RIGHTS            0.00           0.00           0.00           0.00


APPROACH        A: STANIFORD N B: STANIFORD S C: O'CONNELL W D:
                 LT   TH   RT   LT   TH   RT   LT   TH   RT   LT   TH   RT
VOLUME           63  492    0    6  393   90  185    0   12    0    0    0
PHF               0.89           0.87           0.84           1.00
ADJ VOLUME       71  553    0    7  452  103  220    0   14    0    0    0
PERCENT GRADE     0.00           0.00           0.00
PERCENT CYCLES      0.00           0.00           0.00           0.00
PASSENGER CARS     99.00          99.00          99.00           0.00
PERCENT LT TRU      0.00           0.00           0.00           0.00
PERCENT HV TRU      1.00           1.00           1.00           0.00
PASS CAR/HR      71              7            222    0   14    0    0    0


STEP 1 RIGHT TURNS FROM     C:O'CONNELL WAY          D:
CONFLICTING FLOWS                      276                 278
CRITICAL GAPS                          5.2                 4.6
```

```
CAPACITY                          869           995
CAPACITY USED                       2%            0%
IMPEDANCE FACTOR                 0.99          1.00
ACTUAL CAPACITY                   869           995
```

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1985 HCM - CHAPTER 10: UNSIGNALIZED - 4 APPROACHES (PAGE 2 OF 2)
DATE:06-29-1991          TIME:09:23:30
STANIFORD/O'CONNELL - EXISTING PM

STEP 2 LEFT TURNS FROM     B:STANIFORD SB          A:STANIFORD NB
CONFLICTING FLOWS                     553                     555
CRITICAL GAPS                         5.6                     5.6
CAPACITY                              570                     569
CAPACITY USED                          1%                      13%
IMPEDANCE FACTOR                     1.00                    0.92
ACTUAL CAPACITY                       570                     569


STEP 3 THRU MOVES FROM     C:O'CONNELL WAY         D:
CONFLICTING FLOWS                    1186                    1134
CRITICAL GAPS                         6.8                     6.2
CAPACITY                              150                     207
CAPACITY USED                          0%                      0%
IMPEDANCE FACTOR                     1.00                    1.00
ACTUAL CAPACITY                       137                     189


STEP 4 LEFT TURNS FROM     C:O'CONNELL WAY         D:
CONFLICTING FLOWS                    1186                    1148
CRITICAL GAPS                         7.3                     6.7
CAPACITY                              124                     166
ACTUAL CAPACITY                       113                     151


                    SUMMARY OF LEVEL OF SERVICE BY MOVEMENT
MOVEMENT                DEMAND    CAPACITY  RESERVE   LOS  AVG DEL(SEC) AVG QUEUE

LT FROM A:                  71         569      497     A      7.24          0.14
LT FROM B:                   7         570      564     A      6.39          0.01

ALL MOVES FROM C:          237         119     -117     F   INFINITE     INFINITE
```

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CINCH PROGRAM VERSION DATE 4-29-1988
1985 HCM - CHAPTER 9: SIGNALIZED - OPERATIONAL ANALYSIS
CAMBRIDGE ST/STANIFORD ST/TEMPLE STREET
EXISTING AM PEAK HOUR
date:08-12-1991            time:06:29:31
LAST DATA SET NAMES LOADED OR SAVED
VOLUME=           GEOMETRICS=           SIGNAL=
LOCATED IN CBD:Y
VOLUME & GEOMETRICS
        VOLUMES      # OF LANES     LANE WIDTH     CROSS
DIR  LT   TH   RT    LT TH RT      LT   TH   RT    WALK
EB  300 1008    0     1  2  0    11.0 11.0  0.0     0
WB    0  831  135     0  2  0     0.0 12.0  0.0     0
NB    1    3    1     0  1  0     0.0 12.0  0.0     0
SB  165    0  286     1  0  1    12.0  0.0 12.0     0

TRAFFIC & ROADWAY CONDITIONS
                  ADJ PARK              PEDESTRIANS       ARR
DIR GRADE %HV   Y/N MOVES BUSES  PHF CROSS BUT MIN TIME TYPE
EB  0.0%  1.0%        0     0   .800   0          7.0    4
WB  0.0%  1.0%        0     0   .880   0          7.0    4
NB  0.0%  0.0%        0     0   .420   0          7.0    3
SB  0.0%  1.0%        0     0   .870   0          7.0    3

PHASINGS
    EASTBOUND   WESTBOUND   NORTHBOUND  SOUTHBOUND GREEN  Y+R PRE/ACT
    l  t  r  p  l  t  r  p  l  t  r  p  l  t  r  p
 1     *              *  *                           38.7   4    A
 2  *  *                                      *      26.8   4    A
 3                          *  *  *     *     *      12.5   4    A

CYCLE=  90.0

VOLUME ADJUSTMENT WORKSHEET
PART 1 (MOVEMENT ADJUSTMENTS)
DIR  LTV  THV  RTV   PHF  LTFR THFR RTFR
EB   300 1008    0  .800   375 1260    0
WB     0  831  135  .880     0  944  153
NB     1    3    1  .420     2    7    2
SB   165    0  286  .870   190    0  329

PART 2 (LANE GROUP ADJUSTMENTS)
DIR LN GROUP   FLOW N   LU     v  Plt  Prt
EB  LT          375 1 1.00   375 1.00 0.00
EB  TH         1260 2 1.05  1323 0.00 0.00
WB  TH-RT      1098 2 1.05  1153 0.00 0.14
NB  LT-TH-RT     12 1 1.00    12 0.20 0.20
SB  LT          190 1 1.00   190 1.00 0.00
SB  RT          329 1 1.00   329 0.00 1.00

PART 3 (OPPOSING VOLUME ADJUSTMENTS)
LEFT TURN                OPPOSING APPROACH
BEING OPPOSED        VOLUMES       % OPPOSING LEFT TURN     # LANES      OPPOSING
                   LT   TH   RT       LT   TH   RT         LT  TH  RT     VOLUME
EASTBOUND           0  944  153        0    0    0          0   2   0        0
NORTHBOUND        190    0  329      100    0    0          1   0   1        0
SOUTHBOUND          2    7    2      100  100  100          0   1   0       10

SATURATION FLOW ADJUSTMENT WORKSHEET
```

```
DIR LN GROUP   IDEAL N  Fwid   Fhv    Fgr  Fpark  Fbus Farea   Frt    Flt    s
EB  LT         1800  1 0.967 0.995 1.000 1.000 1.000 0.900 1.000 0.950 1480
EB  TH         1800  2 0.967 0.995 1.000 1.000 1.000 0.900 1.000 1.000 3116
WB  TH-RT      1800  2 1.000 0.995 1.000 1.000 1.000 0.900 0.979 1.000 3156
NB  LT-TH-RT   1800  1 1.000 1.000 1.000 1.000 1.000 0.900 0.873 0.873 1235
SB  LT         1800  1 1.000 0.995 1.000 1.000 1.000 0.900 1.000 1.000 1612
SB  RT         1800  1 1.000 0.995 1.000 1.000 1.000 0.900 0.850 1.000 1370

SUPPLEMENTAL WORKSHEET FOR LEFT-TURN ADJUSTMENT FACTOR FLT
INPUT VARIABLES
DIR  C   G  N   Va   Vm  Vlt  Plt No   Vo Plto
SB  90  12  1  190  329  190 1.00  1   10 0.20
CALCULATIONS
DIR Sop    Yo     Gu     Fs     Pl     Gq    Pt     Gf       El    Fm   Flt
SB 1584 0.006 11.997 0.869 1.000  0.469 0.000  0.000    1.295 1.000 1.000

CAPACITY ANALYSIS WORKSHEET
DIR LN GROUP     v    s  v/s  g/C    c  v/c  CRITICAL
EB  LT         375 1480 0.25 0.30  441 0.85     *
EB  TH        1323 3116 0.42 0.77 2408 0.55
WB  TH-RT     1153 3156 0.37 0.43 1357 0.85     *
NB  LT-TH-RT    12 1235 0.01 0.14  171 0.07
SB  LT         190 1612 0.12 0.14  223 0.85     *
SB  RT         329 1370 0.24 0.48  659 0.50

CYCLE= 90.0  LOST=12.0  SUM V/S CRIT= 0.74 TOTAL V/C= 0.85

LEVEL OF SERVICE WORKSHEET
DIR LN GROUP  v/c  g/C   C     d1    c      d2   PF    Delay LOS Avg Q  95% Q
EB  LT        0.85 0.30  90.0  22.56  441   10.06 1.00   32.62  D   6.7
EB  TH        0.55 0.77  90.0   3.07 2408    0.21 0.62    2.04  A   7.2
WB  TH-RT     0.85 0.43  90.0  17.51 1357    3.77 0.73   15.52  C  15.6
NB  LT-TH-RT  0.07 0.14  90.0  25.63  171    0.00 0.85   21.79  C   0.3
SB  LT        0.85 0.14  90.0  28.77  223   17.28 0.85   39.14  D   4.1
SB  RT        0.50 0.48  90.0  12.11  659    0.51 0.85   10.73  B   4.3

DIR Delay LOS
EB   8.79  B
WB  15.52  C
NB  21.79  C
SB  21.12  C
INTERSECTION DELAY = 13.02 INTERSECTION LOS=B

THE CYCLE LENGTH WITHIN THE BOUNDS OF  90  TO  90 SECONDS
WHICH MINIMIZES CRITICAL MOVEMENT DELAY IS  90.0 SECONDS

FOR A V/C RATIO OF .95 THE CYCLE SHOULD BE  53.3 SECONDS
THE EXISTING TIMING IS OPTIMAL
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CINCH PROGRAM VERSION DATE 4-29-1988
1985 HCM - CHAPTER 9: SIGNALIZED - OPERATIONAL ANALYSIS
CAMBRIDGE ST/STANIFORD ST/TEMPLE STREET
EXISTING PM
date:08-12-1991             time:06:27:33
LAST OATA SET NAMES LOADED OR SAVED
VOLUME=            GEOMETRICS=          SIGNAL=
LOCATED IN CBD:Y
VOLUME & GEOMETRICS
        VOLUMES      # OF LANES     LANE WIDTH     CROSS
OIR  LT   TH   RT    LT TH RT      LT   TH   RT    WALK
EB  479  811    0     1  2  0    11.0 11.0  0.0     0
WB    0  939  327     0  2  0     0.0 12.0  0.0     0
NB    2    0    0     0  1  0     0.0 12.0  0.0     0
SB  213    0  302     1  0  1    12.0  0.0 12.0     0

TRAFFIC & ROADWAY CONDITIONS
                 ADJ PARK             PEDESTRIANS       ARR
DIR GRADE %HV   Y/N MOVES BUSES  PHF CROSS BUT MIN TIME TYPE
EB  0.0%  0.0%         0     0  .870    0         7.0    4
WB  0.0%  1.0%         0     0  .910    0         7.0    4
NB  0.0%  0.0%         0     0  .500    0         7.0    3
SB  0.0%  1.0%         0     0  .930    0         7.0    3

PHASINGS
    EASTBOUND   WESTBOUND   NORTHBOUND  SOUTHBOUND GREEN  Y+R PRE/ACT
    l  t  r  p  l  t  r  p  l  t  r  p  l  t  r  p
 1     *              *  *                           41.9   4    A
 2  *  *                                      *      32.9   4    A
 3                          *  *  *     *     *      13.3   4    A

CYCLE= 100.0

VOLUME ADJUSTMENT WORKSHEET
PART 1 (MOVEMENT ADJUSTMENTS)
DIR  LTV  THV  RTV   PHF  LTFR THFR RTFR
EB   479  811    0  .870   551  932    0
WB     0  939  327  .910     0 1032  359
NB     2    0    0  .500     4    0    0
SB   213    0  302  .930   229    0  325

PART 2 (LANE GROUP ADJUSTMENTS)
DIR LN GROUP  FLOW N   LU     v  Plt  Prt
EB  LT         551 1 1.00  551 1.00 0.00
EB  TH         932 2 1.05  979 0.00 0.00
WB  TH-RT     1391 2 1.05 1461 0.00 0.26
NB  LT           4 0 0.00    0 1.00 0.00
NB  LT-TH        4 1 1.00    4 1.00 0.00
SB  LT         229 1 1.00  229 1.00 0.00
SB  RT         325 1 1.00  325 0.00 1.00

PART 3 (OPPOSING VOLUME ADJUSTMENTS)
LEFT TURN                OPPOSING APPROACH
BEING OPPOSED        VOLUMES       % OPPOSING LEFT TURN     # LANES      OPPOSING
                  LT   TH   RT        LT    TH    RT       LT  TH  RT     VOLUME
EASTBOUND          0 1032  359         0     0     0        0   2   0          0
NORTHBOUND       229    0  325       100     0     0        1   0   1          0
SOUTHBOUND         4    0    0       100   100   100        0   1   0          0
```

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SATURATION FLOW ADJUSTMENT WORKSHEET
DIR LN GROUP   IDEAL N  Fwid   Fhv   Fgr Fpark  Fbus Farea   Frt   Flt    s
EB  LT          1800  1 0.967 1.000 1.000 1.000 1.000 0.900 1.000 0.950 1488
EB  TH          1800  2 0.967 1.000 1.000 1.000 1.000 0.900 1.000 1.000 3132
WB  TH-RT       1800  2 1.000 0.995 1.000 1.000 1.000 0.900 0.961 1.000 3099
NB  LT          1800  0 0.600 1.000 1.000 1.000 1.000 0.900 1.000 0.000    0
NB  LT-TH       1800  1 1.000 1.000 1.000 1.000 1.000 0.900 1.000 0.765 1239
SB  LT          1800  1 1.000 0.995 1.000 1.000 1.000 0.900 1.000 0.950 1531
SB  RT          1800  1 1.000 0.995 1.000 1.000 1.000 0.900 0.850 1.000 1370

CAPACITY ANALYSIS WORKSHEET
DIR LN GROUP     v    s  v/s  g/C    c  v/c  CRITICAL
EB  LT         551 1488 0.37 0.33  489 1.13     *
EB  TH         979 3132 0.31 0.79 2465 0.40
WB  TH-RT     1461 3099 0.47 0.42 1297 1.13     *
NB  LT           0    0 0.00 0.13    0 0.00
NB  LT-TH        4 1239 0.00 0.13  165 0.02
SB  LT         229 1531 0.15 0.13  203 1.13     *
SB  RT         325 1370 0.24 0.50  687 0.47

CYCLE=100.0  LOST=12.0  SUM V/S CRIT= 0.99 TOTAL V/C= 1.13

LEVEL OF SERVICE WORKSHEET
DIR LN GROUP  v/c  g/C   C      d1    c      d2   PF   Delay LOS Avg Q  95% Q
EB  LT       1.13 0.33 100.0  27.19  489   78.08 1.00  105.27  F  21.2
EB  TH       0.40 0.79 100.0   2.50 2465    0.06 0.62    1.59  A   5.5
WB  TH-RT    1.13 0.42 100.0  24.30 1297   65.56 0.81   73.21  F  39.5
NB  LT       0.00 0.13 100.0   0.00    0    0.00 1.00    0.00  A   0.1
NB  LT-TH    0.02 0.13 100.0  28.67  165    0.00 0.85   24.37  C   0.1
SB  LT       1.13 0.13 100.0  33.60  203   98.61 0.85  112.38  F   9.9
SB  RT       0.47 0.50 100.0  12.38  687    0.40 0.85   10.86  B   4.5

DIR Delay LOS
EB  38.91  D
WB  73.21  F
NB  24.37  C
SB  52.85  E
INTERSECTION DELAY = 55.19 INTERSECTION LOS=E

THE CYCLE LENGTH WITHIN THE BOUNDS OF  100  TO  100 SECONDS
WHICH MINIMIZES CRITICAL MOVEMENT DELAY IS 100.0 SECONDS

THE V/C RATIO CAN'T BE .95 FOR THE GIVEN CONDITIONS
THE EXISTING TIMING IS OPTIMAL
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CINCH PROGRAM VERSION DATE 4-29-1988
1985 HCM - CHAPTER 9: SIGNALIZED - OPERATIONAL ANALYSIS
CAMBRIDGE STREET/BLOSSOM STREET
AM NO-BUILD
date:08-05-1991             time:03:13:14
LAST DATA SET NAMES LOADED OR SAVED
VOLUME=            GEOMETRICS=           SIGNAL=
LOCATED IN CBD:Y
VOLUME & GEOMETRICS
        VOLUMES       # OF LANES     LANE WIDTH     CROSS
DIR  LT   TH   RT     LT TH RT      LT   TH   RT     WALK
EB  100 1357    0      1  2  0    12.0 12.0  0.0      0
WB    0  783   62      0  2  0     0.0 12.0  0.0      0
NB   15    4   11      0  1  0     0.0 12.0  0.0      0
SB   95    0  172      1  0  1    12.0  0.0 12.0      0

TRAFFIC & ROADWAY CONDITIONS
                 ADJ PARK            PEDESTRIANS        ARR
DIR GRADE %HV   Y/N MOVES BUSES  PHF CROSS BUT MIN TIME TYPE
EB  0.0%  2.0%          0    0  .980   0         7.0   4
WB  0.0%  2.0%          0    0  .970   0         7.0   4
NB  0.0%  0.0%   0      0    0  .750   0         7.0   3
SB  0.0%  7.0%          0    0  .880   0         7.0   3

PHASINGS
    EASTBOUND   WESTBOUND   NORTHBOUND  SOUTHBOUND GREEN  Y+R PRE/ACT
    l  t  r  p  l  t  r  p  l  t  r  p  l  t  r  p
 1     *  *        *  *                             54.5   4    A
 2  *  *                                   *        12.7   4    A
 3                          *  *  *     *     *     10.8   4    A

CYCLE=  90.0

VOLUME ADJUSTMENT WORKSHEET
PART 1 (MOVEMENT ADJUSTMENTS)
DIR  LTV  THV  RTV   PHF  LTFR THFR RTFR
EB   100 1357    0  .980   102 1385    0
WB     0  783   62  .970     0  807   64
NB    15    4   11  .750    20    5   15
SB    95    0  172  .880   108    0  195

PART 2 (LANE GROUP ADJUSTMENTS)
DIR LN GROUP   FLOW N   LU     v  Plt  Prt
EB  LT          102 1 1.00   102 1.00 0.00
EB  TH         1385 2 1.05  1454 0.00 0.00
WB  TH-RT       871 2 1.05   915 0.00 0.07
NB  LT-TH-RT     40 1 1.00    40 0.50 0.37
SB  LT          108 1 1.00   108 1.00 0.00
SB  RT          195 1 1.00   195 0.00 1.00

PART 3 (OPPOSING VOLUME ADJUSTMENTS)
LEFT TURN                OPPOSING APPROACH
BEING OPPOSED        VOLUMES       % OPPOSING LEFT TURN     # LANES      OPPOSING
                  LT   TH   RT        LT    TH    RT        LT  TH  RT     VOLUME
EASTBOUND          0  807   64         0     0     0         0   2   0        0
NORTHBOUND       108    0  195       100     0     0         1   0   1        0
SOUTHBOUND        20    5   15       100   100   100         0   1   0       20

SATURATION FLOW ADJUSTMENT WORKSHEET
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```
DIR LN GROUP   IDEAL N  Fwid   Fhv   Fgr Fpark  Fbus Farea   Frt   Flt    s
EB  LT          1800  1 1.000 0.990 1.000 1.000 1.000 0.900 1.000 0.950 1524
EB  TH          1800  2 1.000 0.990 1.000 1.000 1.000 0.900 1.000 1.000 3208
WB  TH-RT       1800  2 1.000 0.990 1.000 1.000 1.000 0.900 0.989 1.000 3173
NB  LT-TH-RT    1800  1 1.000 1.000 1.000 1.000 1.000 0.900 0.851 0.833 1147
SB  LT          1800  1 1.000 0.966 1.000 1.000 1.000 0.900 1.000 1.000 1565
SB  RT          1800  1 1.000 0.966 1.000 1.000 1.000 0.900 0.850 1.000 1330

SUPPLEMENTAL WORKSHEET FOR LEFT-TURN ADJUSTMENT FACTOR FLT
INPUT VARIABLES
DIR  C   G  N   Va   Vm  Vlt  Plt No   Vo Plto
SB  90  11  1  108  195  108 1.00  1   20 0.50
CALCULATIONS
DIR Sop    Yo     Gu    Fs    Pl     Gq    Pt     Gf       El    Fm   Flt
SB 1443 0.014  9.718 0.863 1.000  1.113 0.000  0.000    1.304 1.000 1.000

CAPACITY ANALYSIS WORKSHEET
DIR LN GROUP     v     s  v/s  g/C     c  v/c  CRITICAL
EB  LT         102 1524 0.07 0.14  214 0.48
EB  TH        1454 3208 0.45 0.79 2537 0.57      *
WB  TH-RT      915 3173 0.29 0.61 1922 0.48
NB  LT-TH-RT    40 1147 0.03 0.12  138 0.29
SB  LT         108 1565 0.07 0.12  188 0.57      *
SB  RT         195 1330 0.15 0.31  406 0.48

CYCLE= 90.0  LOST= 8.0  SUM V/S CRIT= 0.52 TOTAL V/C= 0.57

LEVEL OF SERVICE WORKSHEET
DIR LN GROUP  v/c  g/C   C     d1    c      d2   PF   Delay LOS Avg Q  95% Q
EB  LT        0.48 0.14  90.0  27.07  214    1.29 1.00  28.36  D   2.2
EB  TH        0.57 0.79  90.0   2.74 2537    0.24 0.62   1.85  A   7.2
WB  TH-RT     0.48 0.61  90.0   7.47 1922    0.15 0.62   4.72  A   8.6
NB  LT-TH-RT  0.29 0.12  90.0  27.42  138    0.34 0.85  23.59  C   0.9
SB  LT        0.57 0.12  90.0  28.42  188    3.05 0.85  26.75  D   2.4
SB  RT        0.48 0.31  90.0  19.34  406    0.72 0.85  17.05  C   3.4

DIR Delay LOS
EB   3.58  A
WB   4.72  A
NB  23.59  C
SB  20.50  C
INTERSECTION DELAY =  6.06 INTERSECTION LOS=B

THE CYCLE LENGTH WITHIN THE BOUNDS OF  90  TO  90 SECONDS
WHICH MINIMIZES CRITICAL MOVEMENT DELAY IS  90.0 SECONDS

FOR A V/C RATIO OF .95 THE CYCLE SHOULD BE  17.8 SECONDS
THE EXISTING TIMING IS OPTIMAL
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CINCH PROGRAM VERSION DATE 4-29-1988
1985 HCM - CHAPTER 9: SIGNALIZED - OPERATIONAL ANALYSIS
CAMBRIDGE STREET/BLOSSOM STREET
PM NO-BUILD
date:08-05-1991             time:03:09:04
LAST DATA SET NAMES LOADED OR SAVED
VOLUME=            GEOMETRICS=           SIGNAL=
LOCATED IN CBD:Y
VOLUME & GEOMETRICS
        VOLUMES       # OF LANES     LANE WIDTH     CROSS
DIR  LT   TH   RT     LT TH RT      LT   TH   RT    WALK
EB  328 1535    0      1  2  0     12.0 12.0  0.0     0
WB    0 1694  129      0  2  1      0.0 12.0 12.0     0
NB    9   11   18      0  1  0      0.0 12.0  0.0     0
SB  151    0  251      1  0  1     12.0  0.0 12.0     0

TRAFFIC & ROADWAY CONDITIONS
                 ADJ PARK               PEDESTRIANS         ARR
DIR GRADE %HV   Y/N MOVES BUSES  PHF CROSS BUT MIN TIME TYPE
EB  0.0%  1.0%        0     0   .920   0          7.0    4
WB  0.0%  2.0%        0     0   .880   0          7.0    4
NB  0.0%  0.0%   0    0     0   .730   0          7.0    3
SB  0.0%  0.0%        0     0   .920   0          7.0    3

PHASINGS
    EASTBOUND   WESTBOUNO   NORTHBOUND  SOUTHBOUND GREEN  Y+R PRE/ACT
    l  t  r  p  l  t  r  p  l  t  r  p  l  t  r  p
 1     *  *        *  *                              51.0   4    A
 2  *  *                                      *      18.8   4    A
 3                          *  *  *     *     *       8.2   4    A

CYCLE=  90.0

VOLUME ADJUSTMENT WORKSHEET
PART 1 (MOVEMENT ADJUSTMENTS)
DIR  LTV  THV  RTV   PHF  LTFR THFR RTFR
EB   328 1535    0  .920   357 1668    0
WB     0 1694  129  .880     0 1925  147
NB     9   11   18  .730    12   15   25
SB   151    0  251  .920   164    0  273

PART 2 (LANE GROUP ADJUSTMENTS)
DIR LN GROUP   FLOW N   LU     v  Plt  Prt
EB  LT          357 1 1.00  357 1.00 0.00
EB  TH         1668 2 1.05 1752 0.00 0.00
WB  TH         1925 2 1.05 2021 0.00 0.00
WB  RT          147 1 1.00  147 0.00 1.00
NB  LT-TH-RT     52 1 1.00   52 0.24 0.47
SB  LT          164 1 1.00  164 1.00 0.00
SB  RT          273 1 1.00  273 0.00 1.00

PART 3 (OPPOSING VOLUME ADJUSTMENTS)
LEFT TURN               OPPOSING APPROACH
BEING OPPOSED        VOLUMES       % OPPOSING LEFT TURN    # LANES     OPPOSING
                  LT   TH   RT       LT   TH   RT        LT  TH  RT     VOLUME
EASTBOUND          0 1925  147        0    0    0         0   2   1        0
NORTHBOUND       164    0  273      100    0    0         1   0   1        0
SOUTHBOUND        12   15   25      100  100  100         0   1   0       40
```

```
SATURATION FLOW ADJUSTMENT WORKSHEET
DIR LN GROUP  IDEAL N  Fwid   Fhv   Fgr Fpark  Fbus Farea   Frt   Flt    s
EB  LT         1800  1 1.000 0.995 1.000 1.000 1.000 0.900 1.000 0.950 1531
EB  TH         1800  2 1.000 0.995 1.000 1.000 1.000 0.900 1.000 1.000 3224
WB  TH         1800  2 1.000 0.990 1.000 1.000 1.000 0.900 1.000 1.000 3208
WB  RT         1800  1 1.000 0.990 1.000 1.000 1.000 0.900 0.850 1.000 1363
NB  LT-TH-RT   1800  1 1.000 1.000 1.000 1.000 1.000 0.900 0.836 0.868 1176
SB  LT         1800  1 1.000 1.000 1.000 1.000 1.000 0.900 1.000 1.000 1620
SB  RT         1800  1 1.000 1.000 1.000 1.000 1.000 0.900 0.850 1.000 1377

SUPPLEMENTAL WORKSHEET FOR LEFT-TURN ADJUSTMENT FACTOR FLT
INPUT VARIABLES
DIR  C   G  N   Va   Vm  Vlt  Plt No   Vo Plto
SB  90   8  1  164  273  164 1.00  1   40 0.24
CALCULATIONS
DIR Sop    Yo     Gu    Fs    Pl     Gq    Pt     Gf       El    Fm   Flt
SB 1577 0.025  6.082 0.850 1.000  2.114 0.000  0.000    1.323 1.000 1.000

CAPACITY ANALYSIS WORKSHEET
DIR LN GROUP     v    s  v/s  g/C    c  v/c  CRITICAL
EB  LT         357 1531 0.23 0.21  320 1.11     *
EB  TH        1752 3224 0.54 0.82 2644 0.66
WB  TH        2021 3208 0.63 0.57 1817 1.11     *
WB  RT         147 1363 0.11 0.57  772 0.19
NB  LT-TH-RT    52 1176 0.04 0.09  107 0.49
SB  LT         164 1620 0.10 0.09  148 1.11     *
SB  RT         273 1377 0.20 0.34  475 0.57

CYCLE= 90.0  LOST=12.0  SUM V/S CRIT= 0.96 TOTAL V/C= 1.11

LEVEL OF SERVICE WORKSHEET
DIR LN GROUP  v/c  g/C    C     d1    c      d2   PF   Delay LOS Avg Q  95% Q
EB  LT        1.11 0.21  90.0  27.87  320   80.03 1.00  107.90  F  14.2
EB  TH        0.66 0.82  90.0   2.43 2644    0.45 0.65    1.87  A   7.5
WB  TH        1.11 0.57  90.0  17.39 1817   56.20 0.81   59.69  E  42.4
WB  RT        0.19 0.57  90.0   7.21  772    0.02 0.62    4.48  A   1.6
NB  LT-TH-RT  0.49 0.09  90.0  29.56  107    2.72 0.85   27.44  D   1.2
SB  LT        1.11 0.09  90.0  31.44  148  102.29 0.85  113.67  F   7.0
SB  RT        0.57 0.34  90.0  18.31  475    1.27 0.85   16.64  C   4.5

DIR Delay LOS
EB  19.80  C
WB  55.95  E
NB  27.44  D
SB  53.09  E
INTERSECTION DELAY = 39.38 INTERSECTION LOS=D

THE CYCLE LENGTH WITHIN THE BOUNDS OF  90  TO  90 SECONDS
WHICH MINIMIZES CRITICAL MOVEMENT DELAY IS  90.0 SECONDS

THE V/C RATIO CAN'T BE .95 FOR THE GIVEN CONDITIONS
THE EXISTING TIMING IS OPTIMAL
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CINCH PROGRAM VERSION DATE 4-29-1988
1985 HCM - CHAPTER 10 : UNSIGNALIZED - 3 APPROACHES (PAGE 1 of 2)
DATE:06-29-1991             TIME:12:50:12
BLOSSOM ST/O'CONNELL WAY - AM NB


LAST DATASETS LOADED OR SAVED
VOLUME=BLSMAN     GEOMETRICS=BLSM
KEY: A- -B
        |
        C
GENERAL CHARACTERISTICS
POPULATION GREATER THAN 250,000: YES
CONTROLS: FROM C: STOP
PREVAILING SPEED:  35  MPH
MAIN STREET # OF LANES: 4 LANES
MAIN STREET APPROACH A - EXCLUSIVE RIGHT TURN LANE: N

MINOR STREET LANES
APPROACH: C: O'CONNELL
SHARED LEFT AND RIGHT TURN LANE: YES
LARGE RIGHT TURN RADIUS OR SHALLOW RIGHT TURN ANGLE: NO
RIGHT TURN ACCELERATION LANE ON MAJOR: NO


SIGHT DISTANCE RESTRICTIONS (in seconds)
APPROACH         A: BLOSSOM NB  B: BLOSSOM SB  C: O'CONNELL
LEFTS              0.00           0.00           0.00
THRUS              0.00           0.00           0.00
RIGHTS             0.00           0.00           0.00


APPROACH         A: BLOSSOM NB  B: BLOSSOM SB  C: O'CONNELL
                  LT   TH   RT   LT   TH   RT   LT   TH   RT
VOLUME             0  130   84   79  136    0   44    0  131
PHF                0.76           0.90           0.86
ADJ VOLUME         0  171  111   88  151    0   51    0  152
PERCENT GRADE      0.00           0.00           0.00
PERCENT CYCLES       0.00           0.00           0.00
PASSENGER CARS     99.00          99.00          %100.00
PERCENT LT TRU       0.00           0.00           0.00
PERCENT HV TRU       1.00           1.00           0.00
PASS CAR/HR        0              89             51    0  152


STEP 1 RIGHT TURNS FROM      C:O'CONNELL
CONFLICTING FLOWS                       141
CRITICAL GAPS                           5.2
CAPACITY                               1004
ACTUAL CAPACITY                        1004


STEP 2 LEFT TURNS FROM      B:BLOSSOM SB
CONFLICTING FLOWS                       282
CRITICAL GAPS                           5.1
```

```
CAPACITY                               883
CAPACITY USED                           10%
IMPEDANCE FACTOR                      0.94
ACTUAL CAPACITY                        883
```

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1985 HCM - CHAPTER 10 : UNSIGNALIZED - 3 APPROACHES (PAGE 2 of 2)
DATE:06-29-1991           TIME:12:50:12
BLOSSOM ST/O'CONNELL WAY - AM NB


STEP 3 LEFT TURNS FROM      C:O'CONNELL
CONFLICTING FLOWS                      465
CRITICAL GAPS                          6.8
CAPACITY                               477
ACTUAL CAPACITY                        448


                  SUMMARY OF LEVEL OF SERVICE BY MOVEMENT
MOVEMENT                 DEMAND    CAPACITY  RESERVE   LOS  AVG DEL(SEC) AVG QUEUE

LT FROM B:                  89        883       795     A       4.53          0.11

ALL MOVES FROM C:          203        765       562     A       6.41          0.36
```

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CINCH PROGRAM VERSION DATE 4-29-1988
1985 HCM - CHAPTER 10: UNSIGNALIZED - 4 APPROACHES (PAGE 1 OF 2)
DATE:08-05-1991             TIME:20:50:45
BLOSSOM STREET/O'CONNELL WAY - PM NO-BUILD


LAST DATASETS LOADED OR SAVED
VOLUME=           GEOMETRICS=
KEY:   D
       |
     A- -B
       |
       C
GENERAL CHARACTERISTICS
POPULATION GREATER THAN 250,000: YES
CONTROLS: FROM C: STOP
          FROM D: STOP
PREVAILING SPEED:  35  MPH
MAIN STREET # OF LANES: 4 LANES
MAIN STREET APPROACH A - EXCLUSIVE RIGHT TURN LANE: NO
MAIN STREET APPROACH B - EXCLUSIVE RIGHT TURN LANE: NO

MINOR STREET LANES

APPROACH: C: NO DRIVE
EXCLUSIVE LEFT TURN LANES: NO
EXCLUSIVE RIGHT TURN LANES: NO
LARGE RIGHT TURN RADIUS OR SHALLOW RIGHT TURN ANGLE: NO
RIGHT TURN ACCELERATION LANE ON MAJOR: NO

APPROACH: D: O'CONNELL
EXCLUSIVE LEFT TURN LANES: NO
EXCLUSIVE RIGHT TURN LANES: NO
LARGE RIGHT TURN RADIUS OR SHALLOW RIGHT TURN ANGLE: NO
RIGHT TURN ACCELERATION LANE ON MAJOR: NO

SIGHT DISTANCE RESTRICTIONS (in seconds)
APPROACH        A: BLOSSOM NB  B: BLOSSOM SB  C: NO DRIVE    D: O'CONNELL
LEFTS             0.00           0.00           0.00           0.00
THRUS             0.00           0.00           0.00           0.00
RIGHTS            0.00           0.00           0.00           0.00


APPROACH        A: BLOSSOM NB  B: BLOSSOM SB  C: NO DRIVE    D: O'CONNELL
                 LT   TH   RT   LT   TH   RT   LT   TH   RT   LT   TH   RT
VOLUME             0 292  134   84  218     0    0    0    0  93     0  87
PHF               0.93           0.95           1.00           0.80
ADJ VOLUME         0 314  144   88  229     0    0    0    0 116    0  109
PERCENT GRADE     0.00           0.00           0.00
PERCENT CYCLES      0.00           0.00           0.00           0.00
PASSENGER CARS     %100.00          %100.00          %100.00          %100.00

PERCENT LT TRU      0.00           0.00           0.00           0.00
PERCENT HV TRU      0.00           0.00           0.00           0.00
PASS CAR/HR        0            88               0    0    0 116    0  109


STEP 1 RIGHT TURNS FROM     C:NO DRIVE               D:O'CONNELL
CONFLICTING FLOWS                       229                 115
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CRITICAL GAPS                        5.2         5.2
CAPACITY                             914        1032
CAPACITY USED                          0%         11%
IMPEDANCE FACTOR                    1.00        0.94
ACTUAL CAPACITY                      914        1032
```

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1985 HCM - CHAPTER 10: UNSIGNALIZED - 4 APPROACHES (PAGE 2 OF 2)
DATE:08-05-1991            TIME:20:50:45
BLOSSOM STREET/O'CONNELL WAY - PM NO-BUILD

STEP 2 LEFT TURNS FROM     B:BLOSSOM SB             A:BLOSSOM NB
CONFLICTING FLOWS                    458                      229
CRITICAL GAPS                        5.6                      5.6
CAPACITY                             641                      842
CAPACITY USED                         14%                       0%
IMPEDANCE FACTOR                    0.91                     1.00
ACTUAL CAPACITY                      641                      842


STEP 3 THRU MOVES FROM     C:NO DRIVE               D:O'CONNELL
CONFLICTING FLOWS                    704                      776
CRITICAL GAPS                        6.8                      6.8
CAPACITY                             332                      296
CAPACITY USED                          0%                       0%
IMPEDANCE FACTOR                    1.00                     1.00
ACTUAL CAPACITY                      302                      270


STEP 4 LEFT TURNS FROM     C:NO DRIVE               D:O'CONNELL
CONFLICTING FLOWS                    813                      776
CRITICAL GAPS                        7.3                      7.3
CAPACITY                             240                      256
ACTUAL CAPACITY                      204                      233


                        SUMMARY OF LEVEL OF SERVICE BY MOVEMENT
MOVEMENT                   DEMAND    CAPACITY  RESERVE   LOS  AVG DEL(SEC) AVG QUEUE

LT FROM B:                   88        641       553      A      6.51         0.16


ALL MOVES FROM D:           225        372       147      D     24.48         1.53
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CINCH PROGRAM VERSION DATE 4-29-1988
1985 HCM - CHAPTER 10: UNSIGNALIZED - 4 APPROACHES (PAGE 1 OF 2)
DATE:08-05-1991              TIME:20:33:52
STANIFORD ST/O'CONNELL WAY - AM NO-BUILD


LAST DATASETS LOADED OR SAVED
VOLUME=           GEOMETRICS=
KEY:   D
       |
    A-   -B
       |
       C
GENERAL CHARACTERISTICS
POPULATION GREATER THAN 250,000: NO
CONTROLS: FROM C: STOP
          FROM D: STOP
PREVAILING SPEED:  35  MPH
MAIN STREET # OF LANES: 4 LANES
MAIN STREET APPROACH A - EXCLUSIVE RIGHT TURN LANE: NO
MAIN STREET APPROACH B - EXCLUSIVE RIGHT TURN LANE: NO

MINOR STREET LANES

APPROACH: C: O'CONNELL
EXCLUSIVE LEFT TURN LANES: NO
EXCLUSIVE RIGHT TURN LANES: NO
LARGE RIGHT TURN RADIUS OR SHALLOW RIGHT TURN ANGLE: NO
RIGHT TURN ACCELERATION LANE ON MAJOR: NO

APPROACH: D: DRIVE
EXCLUSIVE LEFT TURN LANES: NO
EXCLUSIVE RIGHT TURN LANES: NO
LARGE RIGHT TURN RADIUS OR SHALLOW RIGHT TURN ANGLE: NO
RIGHT TURN ACCELERATION LANE ON MAJOR: NO

SIGHT DISTANCE RESTRICTIONS (in seconds)
APPROACH        A: STANIFORD N B: STANIFORD S C: O'CONNELL   D: DRIVE
LEFTS             0.00           0.00           0.00           0.00
THRUS             0.00           0.00           0.00           0.00
RIGHTS            0.00           0.00           0.00           0.00


APPROACH        A: STANIFORD N B: STANIFORD S C: O'CONNELL   D: DRIVE
                 LT   TH   RT   LT   TH   RT   LT   TH   RT   LT   TH   RT
VOLUME           61  413    1    8  367  147   99    0   21    0    0    0
PHF               0.88           0.94           0.85           1.00
ADJ VOLUME       69  469    1    9  390  156  116    0   25    0    0    0
PERCENT GRADE     0.00           0.00           0.00
PERCENT CYCLES      0.00           0.00           0.00           0.00
PASSENGER CARS     98.00          97.00          96.00         %100.00
PERCENT LT TRU      0.00           0.00           0.00           0.00
PERCENT HV TRU      2.00           3.00           4.00           0.00
PASS CAR/HR      71             9             121    0   26    0    0    0
```

```
STEP 1 RIGHT TURNS FROM     C:O'CONNELL        D:DRIVE
CONFLICTING FLOWS                   235             273
CRITICAL GAPS                       5.7             5.7
CAPACITY                            820             784
CAPACITY USED                         3%              0%
IMPEDANCE FACTOR                   0.98            1.00
ACTUAL CAPACITY                     820             784
```

```
1985 HCM - CHAPTER 10: UNSIGNALIZED - 4 APPROACHES (PAGE 2 OF 2)
DATE:08-05-1991             TIME:20:33:52
STANIFORD ST/O'CONNELL WAY - AM NO-BUILD

STEP 2 LEFT TURNS FROM     B:STANIFORD S             A:STANIFORD NB
CONFLICTING FLOWS                      470                 547
CRITICAL GAPS                          5.6                 5.6
CAPACITY                               632                 575
CAPACITY USED                            1%                 12%
IMPEDANCE FACTOR                      0.99                0.92
ACTUAL CAPACITY                        632                 575


STEP 3 THRU MOVES FROM     C:O'CONNELL              D:DRIVE
CONFLICTING FLOWS                     1095                1017
CRITICAL GAPS                          6.8                 6.8
CAPACITY                               175                 200
CAPACITY USED                            0%                  0%
IMPEDANCE FACTOR                      1.00                1.00
ACTUAL CAPACITY                        161                 183


STEP 4 LEFT TURNS FROM     C:O'CONNELL              D:DRIVE
CONFLICTING FLOWS                     1095                1042
CRITICAL GAPS                          7.3                 7.3
CAPACITY                               146                 161
ACTUAL CAPACITY                        134                 145


                    SUMMARY OF LEVEL OF SERVICE BY MOVEMENT
MOVEMENT               DEMAND    CAPACITY  RESERVE   LOS  AVG DEL(SEC) AVG QUEUE

LT FROM A:                71        575       504     A      7.14         0.14
LT FROM B:                 9        632       623     A      5.78         0.01

ALL MOVES FROM C:        147        157        10     E    359.94        14.68
```

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CINCH PROGRAM VERSION DATE 4-29-1988
1985 HCM - CHAPTER 10: UNSIGNALIZED - 4 APPROACHES (PAGE 1 OF 2)
DATE:07-12-1991          TIME:13:32:29
STANIFORD/O'CONNELL - PM NO-BUILD


LAST DATASETS LOADED OR SAVED
VOLUME=STNFDPNB   GEOMETRICS=STNFRD
KEY:   D
       |
    A- -B
       |
       C
GENERAL CHARACTERISTICS
POPULATION GREATER THAN 250,000: YES
CONTROLS: FROM C: STOP
          FROM D: YIELD
PREVAILING SPEED:  35  MPH
MAIN STREET # OF LANES: 4 LANES
MAIN STREET APPROACH A - EXCLUSIVE RIGHT TURN LANE: NO
MAIN STREET APPROACH B - EXCLUSIVE RIGHT TURN LANE: NO

MINOR STREET LANES

APPROACH: C: O'CONNELL WAY
EXCLUSIVE LEFT TURN LANES: NO
EXCLUSIVE RIGHT TURN LANES: NO
LARGE RIGHT TURN RADIUS OR SHALLOW RIGHT TURN ANGLE: NO
RIGHT TURN ACCELERATION LANE ON MAJOR: NO

APPROACH: D:
EXCLUSIVE LEFT TURN LANES: NO
EXCLUSIVE RIGHT TURN LANES: NO
LARGE RIGHT TURN RADIUS OR SHALLOW RIGHT TURN ANGLE: NO
RIGHT TURN ACCELERATION LANE ON MAJOR: NO

SIGHT DISTANCE RESTRICTIONS (in seconds)
APPROACH        A: STANIFORD N B: STANIFORD S C: O'CONNELL W D:
LEFTS             0.00           0.00           0.00           0.00
THRUS             0.00           0.00           0.00           0.00
RIGHTS            0.00           0.00           0.00           0.00


APPROACH        A: STANIFORD N B: STANIFORD S C: O'CONNELL W D:
                 LT   TH   RT   LT   TH   RT   LT   TH   RT   LT   TH   RT
VOLUME           65  507    0    6  405   93  191    0   12    0    0    0
PHF               0.89           0.87           0.84           1.00
ADJ VOLUME       73  570    0    7  466  107  227    0   14    0    0    0
PERCENT GRADE     0.00           0.00           0.00
PERCENT CYCLES      0.00           0.00           0.00           0.00
PASSENGER CARS     99.00          99.00          99.00           0.00
PERCENT LT TRU      0.00           0.00           0.00           0.00
PERCENT HV TRU      1.00           1.00           1.00           0.00
PASS CAR/HR      74              7             230    0   14    0    0    0


STEP 1 RIGHT TURNS FROM     C:O'CONNELL WAY          D:
CONFLICTING FLOWS                     285                 286
CRITICAL GAPS                         5.2                 4.6
```

```
CAPACITY                              861                987
CAPACITY USED                          2%                 0%
IMPEDANCE FACTOR                     0.99               1.00
ACTUAL CAPACITY                       861                987
```

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1985 HCM - CHAPTER 10: UNSIGNALIZED - 4 APPROACHES (PAGE 2 OF 2)
DATE:07-12-1991          TIME:13:32:29
STANIFORD/O'CONNELL - PM NO-BUILD

STEP 2 LEFT TURNS FROM     B:STANIFORD SB          A:STANIFORD NB
CONFLICTING FLOWS                     570                     572
CRITICAL GAPS                         5.6                     5.6
CAPACITY                              559                     557
CAPACITY USED                          1%                     13%
IMPEDANCE FACTOR                     1.00                    0.91
ACTUAL CAPACITY                       559                     557


STEP 3 THRU MOVES FROM     C:O'CONNELL WAY         D:
CONFLICTING FLOWS                    1222                    1169
CRITICAL GAPS                         6.8                     6.2
CAPACITY                              141                     196
CAPACITY USED                          0%                      0%
IMPEDANCE FACTOR                     1.00                    1.00
ACTUAL CAPACITY                       128                     178


STEP 4 LEFT TURNS FROM     C:O'CONNELL WAY         D:
CONFLICTING FLOWS                    1222                    1183
CRITICAL GAPS                         7.3                     6.7
CAPACITY                              115                     157
ACTUAL CAPACITY                       105                     142


                       SUMMARY OF LEVEL OF SERVICE BY MOVEMENT
MOVEMENT                 DEMAND    CAPACITY  RESERVE   LOS  AVG DEL(SEC) AVG QUEUE

LT FROM A:                  74        557       483     A      7.46         0.15
LT FROM B:                   7        559       552     A      6.53         0.01

ALL MOVES FROM C:          244        111      -133     F    INFINITE    INFINITE
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CINCH PROGRAM VERSION DATE 4-29-1988
1985 HCM - CHAPTER 9: SIGNALIZED - OPERATIONAL ANALYSIS
CAMBRIDGE ST/STANIFORD ST/TEMPLE STREET
AM NO-BUILD
date:08-12-1991            time:06:30:33
LAST DATA SET NAMES LOADED OR SAVED
VOLUME=           GEOMETRICS=           SIGNAL=
LOCATED IN CBD:Y
VOLUME & GEOMETRICS
        VOLUMES      # OF LANES     LANE WIDTH     CROSS
DIR  LT   TH   RT    LT TH RT      LT   TH   RT    WALK
EB  309 1039    0     1  2  0    11.0 11.0  0.0     0
WB    0  881  139     0  2  0     0.0 12.0  0.0     0
NB    1    3    1     0  1  0     0.0 12.0  0.0     0
SB  170    0  295     1  0  1    12.0  0.0 12.0     0

TRAFFIC & ROADWAY CONDITIONS
                 ADJ PARK                PEDESTRIANS       ARR
DIR GRADE %HV   Y/N MOVES BUSES  PHF CROSS BUT MIN TIME TYPE
EB  0.0%  1.0%        0     0   .800   0          7.0    4
WB  0.0%  1.0%        0     0   .880   0          7.0    4
NB  0.0%  0.0%        0     0   .420   0          7.0    3
SB  0.0%  1.0%        0     0   .870   0          7.0    3

PHASINGS
    EASTBOUND   WESTBOUND   NORTHBOUND  SOUTHBOUND GREEN  Y+R PRE/ACT
    l  t  r  p  l  t  r  p  l  t  r  p  l  t  r  p
 1     *           *  *                             39.2   4    A
 2  *  *                                      *     26.5   4    A
 3                          *  *  *     *     *     12.3   4    A

CYCLE=  90.0

VOLUME ADJUSTMENT WORKSHEET
PART 1 (MOVEMENT ADJUSTMENTS)
DIR  LTV  THV  RTV   PHF  LTFR THFR RTFR
EB   309 1039    0  .800   386 1299    0
       0  881  139  .880     0 1001  158
NB     1    3    1  .420     2    7    2
SB   170    0  295  .870   195    0  339

PART 2 (LANE GROUP ADJUSTMENTS)
DIR LN GROUP  FLOW N   LU    v  Plt  Prt
EB  LT         386 1 1.00  386 1.00 0.00
EB  TH        1299 2 1.05 1364 0.00 0.00
WB  TH-RT     1159 2 1.05 1217 0.00 0.14
NB  LT-TH-RT    12 1 1.00   12 0.20 0.20
SB  LT         195 1 1.00  195 1.00 0.00
SB  RT         339 1 1.00  339 0.00 1.00

PART 3 (OPPOSING VOLUME ADJUSTMENTS)
LEFT TURN                OPPOSING APPROACH
BEING OPPOSED       VOLUMES      % OPPOSING LEFT TURN    # LANES     OPPOSING
                 LT   TH   RT      LT    TH    RT      LT  TH  RT     VOLUME
EASTBOUND         0 1001  158       0     0     0       0   2   0        0
NORTHBOUND      195    0  339     100     0     0       1   0   1        0
SOUTHBOUND        2    7    2     100   100   100       0   1   0       10

SATURATION FLOW ADJUSTMENT WORKSHEET
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DIR LN GROUP  IDEAL N  Fwid   Fhv   Fgr Fpark  Fbus Farea   Frt   Flt    s
EB  LT         1800  1 0.967 0.995 1.000 1.000 1.000 0.900 1.000 0.950 1480
EB  TH         1800  2 0.967 0.995 1.000 1.000 1.000 0.900 1.000 1.000 3116
WB  TH-RT      1800  2 1.000 0.995 1.000 1.000 1.000 0.900 0.980 1.000 3158
NB  LT-TH-RT   1800  1 1.000 1.000 1.000 1.000 1.000 0.900 0.873 0.873 1235
SB  LT         1800  1 1.000 0.995 1.000 1.000 1.000 0.900 1.000 1.000 1612
SB  RT         1800  1 1.000 0.995 1.000 1.000 1.000 0.900 0.850 1.000 1370

SUPPLEMENTAL WORKSHEET FOR LEFT-TURN ADJUSTMENT FACTOR FLT
INPUT VARIABLES
DIR  C   G  N   Va   Vm  Vlt  Plt No   Vo Plto
SB  90  12  1  195  339  195 1.00  1   10 0.20
CALCULATIONS
DIR Sop    Yo     Gu    Fs    Pl     Gq    Pt     Gf      El    Fm   Flt
SB 1580 0.006 11.848 0.869 1.000  0.471 0.000  0.000    1.295 1.000 1.000

CAPACITY ANALYSIS WORKSHEET
DIR LN GROUP     v    s  v/s  g/C    c  v/c  CRITICAL
EB  LT         386 1480 0.26 0.29  436 0.89     *
EB  TH        1364 3116 0.44 0.77 2413 0.57
WB  TH-RT     1217 3158 0.39 0.44 1374 0.89     *
NB  LT-TH-RT    12 1235 0.01 0.14  169 0.07
SB  LT         195 1612 0.12 0.14  221 0.89     *
SB  RT         339 1370 0.25 0.48  652 0.52

CYCLE= 90.0  LOST=12.0  SUM V/S CRIT= 0.77 TOTAL V/C= 0.89

LEVEL OF SERVICE WORKSHEET
DIR LN GROUP  v/c  g/C   C     d1    c      d2   PF   Delay LOS Avg Q  95% Q
EB  LT       0.89 0.29  90.0  23.02  436   13.45 1.00   36.47  D    7.3
EB  TH       0.57 0.77  90.0   3.10 2413    0.24 0.62    2.07  A    7.3
WB  TH-RT    0.89 0.44  90.0  17.75 1374    5.23 0.74   17.06  C   16.4
NB  LT-TH-RT 0.07 0.14  90.0  25.73  169    0.00 0.85   21.87  C    0.3
SB  LT       0.89 0.14  90.0  28.99  221   22.21 0.85   43.52  E    4.5
SB  RT       0.52 0.48  90.0  12.48  652    0.61 0.85   11.13  B    4.4

DIR Delay LOS
EB   9.66  B
WB  17.06  C
NB  21.87  C
SB  22.97  C
INTERSECTION DELAY = 14.29 INTERSECTION LOS=B

THE CYCLE LENGTH WITHIN THE BOUNDS OF  90  TO  90 SECONDS
WHICH MINIMIZES CRITICAL MOVEMENT DELAY IS  90.0 SECONDS

FOR A V/C RATIO OF .95 THE CYCLE SHOULD BE  62.5 SECONDS
THE EXISTING TIMING IS OPTIMAL
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CINCH PROGRAM VERSION DATE 4-29-1988
1985 HCM - CHAPTER 9: SIGNALIZED - OPERATIONAL ANALYSIS
CAMBRIDGE ST/STANIFORD ST/TEMPLE STREET
PM NO-BUILD
date:08-12-1991            time:06:26:33
LAST DATA SET NAMES LOADED OR SAVED
VOLUME=            GEOMETRICS=            SIGNAL=
LOCATED IN CBD:Y
VOLUME & GEOMETRICS
        VOLUMES      # OF LANES     LANE WIDTH     CROSS
DIR  LT   TH   RT    LT TH RT      LT   TH   RT    WALK
EB  493  848    0     1  2  0    11.0 11.0  0.0     0
WB    0  967  337     0  2  0     0.0 12.0  0.0     0
NB    2    0    0     0  1  0     0.0 12.0  0.0     0
SB  219    0  311     1  0  1    12.0  0.0 12.0     0

TRAFFIC & ROADWAY CONDITIONS
                 ADJ PARK             PEDESTRIANS        ARR
DIR GRADE %HV   Y/N MOVES BUSES  PHF CROSS BUT MIN TIME TYPE
EB  0.0%  0.0%         0    0   .870    0         7.0    4
WB  0.0%  1.0%         0    0   .910    0         7.0    4
NB  0.0%  0.0%         0    0   .500    0         7.0    3
SB  0.0%  1.0%         0    0   .930    0         7.0    3

PHASINGS
    EASTBOUND   WESTBOUND   NORTHBOUND  SOUTHBOUND GREEN  Y+R PRE/ACT
    l  t  r  p  l  t  r  p  l  t  r  p  l  t  r  p
 1     *           *  *                             41.9   4   A
 2  *  *                                      *     32.9   4   A
 3                          *  *  *     *     *     13.3   4   A

CYCLE= 100.0

VOLUME ADJUSTMENT WORKSHEET
PART 1 (MOVEMENT ADJUSTMENTS)
DIR  LTV  THV  RTV   PHF  LTFR THFR RTFR
EB   493  848    0  .870   567  975    0
WB     0  967  337  .910     0 1063    0
NB     2    0    0  .500     4    0    0
SB   219    0  311  .930   235    0  334

PART 2 (LANE GROUP ADJUSTMENTS)
DIR LN GROUP   FLOW N  LU     v  Plt  Prt
EB  LT          567 1 1.00  567 1.00 0.00
EB  TH          975 2 1.05 1023 0.00 0.00
WB  TH-RT      1433 2 1.05 1505 0.00 0.26
NB  LT            4 0 0.00    0 1.00 0.00
NB  LT-TH         4 1 1.00    4 1.00 0.00
SB  LT          235 1 1.00  235 1.00 0.00
SB  RT          334 1 1.00  334 0.00 1.00

PART 3 (OPPOSING VOLUME ADJUSTMENTS)
LEFT TURN                OPPOSING APPROACH
BEING OPPOSED      VOLUMES     % OPPOSING LEFT TURN     # LANES      OPPOSING
                 LT   TH   RT      LT   TH   RT         LT  TH  RT    VOLUME
EASTBOUND         0 1063  370       0    0    0          0   2   0         0
NORTHBOUND      235    0  334     100    0    0          1   0   1         0
SOUTHBOUND        4    0    0     100  100  100          0   1   0         0
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SATURATION FLOW ADJUSTMENT WORKSHEET
DIR LN GROUP  IDEAL N  Fwid   Fhv   Fgr Fpark  Fbus Farea   Frt   Flt    s
EB  LT         1800  1 0.967 1.000 1.000 1.000 1.000 0.900 1.000 0.950 1488
EB  TH         1800  2 0.967 1.000 1.000 1.000 1.000 0.900 1.000 1.000 3132
WB  TH-RT      1800  2 1.000 0.995 1.000 1.000 1.000 0.900 0.961 1.000 3099
NB  LT         1800  0 0.600 1.000 1.000 1.000 1.000 0.900 1.000 0.000    0
NB  LT-TH      1800  1 1.000 1.000 1.000 1.000 1.000 0.900 1.000 0.765 1239
SB  LT         1800  1 1.000 0.995 1.000 1.000 1.000 0.900 1.000 0.950 1531
SB  RT         1800  1 1.000 0.995 1.000 1.000 1.000 0.900 0.850 1.000 1370

CAPACITY ANALYSIS WORKSHEET
DIR LN GROUP     v    s  v/s  g/C    c  v/c  CRITICAL
EB  LT         567 1488 0.38 0.33  489 1.16     *
EB  TH        1023 3132 0.33 0.79 2466 0.42
WB  TH-RT     1505 3099 0.49 0.42 1298 1.16     *
NB  LT           0    0 0.00 0.13    0 0.00
NB  LT-TH        4 1239 0.00 0.13  164 0.02
SB  LT         235 1531 0.15 0.13  203 1.16     *
SB  RT         334 1370 0.24 0.50  687 0.49

CYCLE=100.0  LOST=12.0  SUM V/S CRIT= 1.02 TOTAL V/C= 1.16

LEVEL OF SERVICE WORKSHEET
DIR LN GROUP  v/c  g/C    C     d1    c      d2   PF   Delay LOS Avg Q  95% Q
EB  LT        1.16 0.33 100.0  27.67  489   95.56 1.00  123.24  F  24.7
EB  TH        0.42 0.79 100.0   2.55 2466    0.07 0.62    1.62  A   5.8
WB  TH-RT     1.16 0.42 100.0  24.95 1298   83.36 0.82   89.16  F  47.1
NB  LT        0.00 0.13 100.0   0.00    0    0.00 1.00    0.00  A   0.1
NB  LT-TH     0.02 0.13 100.0  28.68  164    0.00 0.85   24.38  C   0.1
SB  LT        1.16 0.13 100.0  33.78  203  116.48 0.85  127.72  F  11.2
SB  RT        0.49 0.50 100.0  12.51  687    0.45 0.85   11.01  B   4.6

DIR Delay LOS
EB  44.96  E
WB  89.16  F
NB  24.38  C
SB  59.24  E
INTERSECTION DELAY = 65.28 INTERSECTION LOS=F

THE CYCLE LENGTH WITHIN THE BOUNDS OF  100  TO  100 SECONDS
WHICH MINIMIZES CRITICAL MOVEMENT DELAY IS 100.0 SECONDS

THE V/C RATIO CAN'T BE .95 FOR THE GIVEN CONDITIONS
THE EXISTING TIMING IS OPTIMAL
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CINCH PROGRAM VERSION DATE 4-29-1988
1985 HCM - CHAPTER 9: SIGNALIZED - OPERATIONAL ANALYSIS
CAMBRIDGE STREET/BLOSSOM STREET
AM BUILD
date:08-05-1991              time:03:14:17
LAST DATA SET NAMES LOADED OR SAVED
VOLUME=            GEOMETRICS=           SIGNAL=
LOCATED IN CBD:Y
VOLUME & GEOMETRICS
        VOLUMES       # OF LANES      LANE WIDTH      CROSS
DIR  LT   TH   RT    LT TH RT      LT    TH    RT    WALK
EB  114 1357    0     1  2  0    12.0 12.0  0.0      0
WB    0  783   64     0  2  0     0.0 12.0  0.0      0
NB   15    4   11     0  1  0     0.0 12.0  0.0      0
SB   95    0  172     1  0  1    12.0  0.0 12.0      0

TRAFFIC & ROADWAY CONDITIONS
                 ADJ PARK               PEDESTRIANS        ARR
DIR GRADE %HV   Y/N MOVES BUSES  PHF CROSS BUT MIN TIME TYPE
EB  0.0%  2.0%         0     0  .980    0          7.0    4
WB  0.0%  2.0%         0     0  .970    0          7.0    4
NB  0.0%  0.0%   0     0     0  .750    0          7.0    3
SB  0.0%  7.0%         0     0  .880    0          7.0    3

PHASINGS
    EASTBOUND   WESTBOUND   NORTHBOUND  SOUTHBOUND GREEN  Y+R PRE/ACT
    l  t  r  p  l  t  r  p  l  t  r  p  l  t  r  p
 1     *  *        *  *                             53.1    4    A
 2  *  *                                      *     14.0    4    A
 3                          *  *  *     *     *     10.8    4    A

CYCLE=  90.0

VOLUME ADJUSTMENT WORKSHEET
PART 1 (MOVEMENT ADJUSTMENTS)
DIR  LTV  THV  RTV   PHF  LTFR THFR RTFR
EB   114 1357    0  .980   116 1385    0
WB     0  783   64  .970     0  807   66
NB    15    4   11  .750    20    5   15
SB    95    0  172  .880   108    0  195

PART 2 (LANE GROUP ADJUSTMENTS)
DIR LN GROUP   FLOW N   LU     v  Plt  Prt
EB  LT          116 1 1.00   116 1.00 0.00
EB  TH         1385 2 1.05  1454 0.00 0.00
WB  TH-RT       873 2 1.05   917 0.00 0.08
NB  LT-TH-RT     40 1 1.00    40 0.50 0.37
SB  LT          108 1 1.00   108 1.00 0.00
SB  RT          195 1 1.00   195 0.00 1.00

PART 3 (OPPOSING VOLUME ADJUSTMENTS)
LEFT TURN                 OPPOSING APPROACH
BEING OPPOSED        VOLUMES       % OPPOSING LEFT TURN    # LANES     OPPOSING
                  LT    TH    RT       LT    TH    RT     LT  TH  RT     VOLUME
EASTBOUND          0   807    66        0     0     0      0   2   0        0
NORTHBOUND       108     0   195      100     0     0      1   0   1        0
SOUTHBOUND        20     5    15      100   100   100      0   1   0       20

SATURATION FLOW ADJUSTMENT WORKSHEET
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DIR LN GROUP   IDEAL N  Fwid   Fhv    Fgr Fpark  Fbus Farea   Frt   Flt    s
EB  LT          1800  1 1.000 0.990 1.000 1.000 1.000 0.900 1.000 0.950 1524
EB  TH          1800  2 1.000 0.990 1.000 1.000 1.000 0.900 1.000 1.000 3208
WB  TH-RT       1800  2 1.000 0.990 1.000 1.000 1.000 0.900 0.989 1.000 3172
NB  LT-TH-RT    1800  1 1.000 1.000 1.000 1.000 1.000 0.900 0.851 0.833 1147
SB  LT          1800  1 1.000 0.966 1.000 1.000 1.000 0.900 1.000 1.000 1565
SB  RT          1800  1 1.000 0.966 1.000 1.000 1.000 0.900 0.850 1.000 1330

SUPPLEMENTAL WORKSHEET FOR LEFT-TURN ADJUSTMENT FACTOR FLT
INPUT VARIABLES
DIR  C   G  N   Va   Vm  Vlt  Plt No   Vo Plto
SB  90  11  1  108  195  108 1.00  1   20 0.50
CALCULATIONS
DIR Sop    Yo     Gu    Fs    Pl     Gq    Pt    Gf      El    Fm   Flt
SB 1443 0.014  9.718 0.863 1.000  1.113 0.000  0.000   1.304 1.000 1.000

CAPACITY ANALYSIS WORKSHEET
DIR LN GROUP     v    s  v/s  g/C    c  v/c  CRITICAL
EB  LT          116 1524 0.08 0.16  238 0.49
EB  TH         1454 3208 0.45 0.79 2537 0.57     *
WB  TH-RT       917 3172 0.29 0.59 1873 0.49
NB  LT-TH-RT     40 1147 0.03 0.12  138 0.29
SB  LT          108 1565 0.07 0.12  188 0.57     *
SB  RT          195 1330 0.15 0.32  427 0.46

CYCLE= 90.0  LOST= 8.0  SUM V/S CRIT= 0.52 TOTAL V/C= 0.57

LEVEL OF SERVICE WORKSHEET
DIR LN GROUP  v/c  g/C   C     d1     c     d2   PF   Delay LOS Avg Q  95% Q
EB  LT        0.49 0.16  90.0  26.38  238    1.30 1.00  27.68  D   2.5
EB  TH        0.57 0.79  90.0   2.74 2537    0.24 0.62   1.85  A   7.2
WB  TH-RT     0.49 0.59  90.0   8.07 1873    0.17 0.62   5.11  B   8.9
NB  LT-TH-RT  0.29 0.12  90.0  27.42  138    0.34 0.85  23.59  C   0.9
SB  LT        0.57 0.12  90.0  28.42  188    3.05 0.85  26.75  D   2.4
SB  RT        0.46 0.32  90.0  18.50  427    0.57 0.85  16.21  C   3.3

DIR Delay LOS
EB   3.76  A
WB   5.11  B
NB  23.59  C
SB  19.96  C
INTERSECTION DELAY =  6.21 INTERSECTION LOS=B

THE CYCLE LENGTH WITHIN THE BOUNDS OF  90  TO  90 SECONDS
WHICH MINIMIZES CRITICAL MOVEMENT DELAY IS  90.0 SECONDS

FOR A V/C RATIO OF .95 THE CYCLE SHOULD BE  17.8 SECONDS
THE EXISTING TIMING IS OPTIMAL
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CINCH PROGRAM VERSION DATE 4-29-1988
1985 HCM - CHAPTER 9: SIGNALIZED - OPERATIONAL ANALYSIS
CAMBRIDGE STREET/BLOSSOM STREET
PM BUILD
date:08-05-1991             time:03:10:26
LAST DATA SET NAMES LOADED OR SAVED
VOLUME=            GEOMETRICS=            SIGNAL=
LOCATED IN CBD:Y
VOLUME & GEOMETRICS
         VOLUMES       # OF LANES      LANE WIDTH      CROSS
DIR   LT    TH   RT     LT  TH  RT       LT    TH    RT     WALK
EB   330  1535    0      1   2   0     12.0  12.0   0.0      0
WB     0  1694  129      0   2   1      0.0  12.0  12.0      0
NB     9    11   18      0   1   0      0.0  12.0   0.0      0
SB   151     0  256      1   0   1     12.0   0.0  12.0      0

TRAFFIC & ROADWAY CONDITIONS
                    ADJ PARK               PEDESTRIANS         ARR
DIR GRADE  %HV   Y/N MOVES BUSES  PHF CROSS BUT MIN TIME TYPE
EB  0.0%  1.0%         0     0   .920    0          7.0    4
WB  0.0%  2.0%         0     0   .880    0          7.0    4
NB  0.0%  0.0%    0    0     0   .730    0          7.0    3
SB  0.0%  0.0%         0     0   .920    0          7.0    3

PHASINGS
    EASTBOUND   WESTBOUND   NORTHBOUND  SOUTHBOUND GREEN  Y+R PRE/ACT
    l  t  r  p  l  t  r  p  l  t  r  p  l  t  r  p
 1     *  *        *  *                             50.9  4    A
 2  *  *                                       *    18.9  4    A
 3                          *  *  *     *     *      8.2  4    A

CYCLE=  90.0

VOLUME ADJUSTMENT WORKSHEET
PART 1 (MOVEMENT ADJUSTMENTS)
DIR  LTV   THV  RTV   PHF   LTFR THFR RTFR
EB    330 1535    0  .920    359 1668    0
WB      0 1694  129  .880      0 1925  147
NB      9   11   18  .730     12   15   25
SB    151    0  256  .920    164    0  278

PART 2 (LANE GROUP ADJUSTMENTS)
DIR LN GROUP    FLOW N    LU     v  Plt  Prt
EB  LT           359 1 1.00   359 1.00 0.00
EB  TH          1668 2 1.05  1752 0.00 0.00
WB  TH          1925 2 1.05  2021 0.00 0.00
WB  RT           147 1 1.00   147 0.00 1.00
NB  LT-TH-RT      52 1 1.00    52 0.24 0.47
SB  LT           164 1 1.00   164 1.00 0.00
SB  RT           278 1 1.00   278 0.00 1.00

PART 3 (OPPOSING VOLUME ADJUSTMENTS)
LEFT TURN                 OPPOSING APPROACH
BEING OPPOSED        VOLUMES       % OPPOSING LEFT TURN      # LANES      OPPOSING
                   LT    TH    RT       LT    TH    RT        LT  TH  RT     VOLUME
EASTBOUND           0  1925   147        0     0     0         0   2   1        0
NORTHBOUND        164     0   278      100     0     0         1   0   1        0
SOUTHBOUND         12    15    25      100   100   100         0   1   0       40
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SATURATION FLOW ADJUSTMENT WORKSHEET
DIR LN GROUP   IDEAL N  Fwid   Fhv    Fgr  Fpark  Fbus  Farea   Frt    Flt     s
EB  LT          1800  1 1.000 0.995 1.000 1.000 1.000 0.900 1.000 0.950 1531
EB  TH          1800  2 1.000 0.995 1.000 1.000 1.000 0.900 1.000 1.000 3224
WB  TH          1800  2 1.000 0.990 1.000 1.000 1.000 0.900 1.000 1.000 3208
WB  RT          1800  1 1.000 0.990 1.000 1.000 1.000 0.900 0.850 1.000 1363
NB  LT-TH-RT    1800  1 1.000 1.000 1.000 1.000 1.000 0.900 0.836 0.868 1176
SB  LT          1800  1 1.000 1.000 1.000 1.000 1.000 0.900 1.000 1.000 1620
SB  RT          1800  1 1.000 1.000 1.000 1.000 1.000 0.900 0.850 1.000 1377

SUPPLEMENTAL WORKSHEET FOR LEFT-TURN ADJUSTMENT FACTOR FLT
INPUT VARIABLES
DIR  C   G  N   Va   Vm  Vlt  Plt No   Vo Plto
SB  90   8  1  164  278  164 1.00  1   40 0.24
CALCULATIONS
DIR Sop    Yo     Gu     Fs     Pl      Gq     Pt     Gf       El     Fm   Flt
SB 1575 0.025  6.066 0.850 1.000  2.118 0.000  0.000    1.323 1.000 1.000

CAPACITY ANALYSIS WORKSHEET
DIR LN GROUP      v     s  v/s  g/C     c  v/c  CRITICAL
EB  LT          359  1531 0.23 0.21  322 1.11     *
EB  TH         1752  3224 0.54 0.82 2644 0.66
WB  TH         2021  3208 0.63 0.57 1814 1.11     *
WB  RT          147  1363 0.11 0.57  771 0.19
NB  LT-TH-RT     52  1176 0.04 0.09  107 0.49
SB  LT          164  1620 0.10 0.09  147 1.11     *
SB  RT          278  1377 0.20 0.35  476 0.58

CYCLE= 90.0  LOST=12.0  SUM V/S CRIT= 0.97 TOTAL V/C= 1.11

LEVEL OF SERVICE WORKSHEET
DIR LN GROUP  v/c  g/C    C      d1     c       d2    PF   Delay LOS Avg Q  95% Q
EB  LT        1.11 0.21  90.0  27.86  322    80.70 1.00  108.56  F  14.4
EB  TH        0.66 0.82  90.0   2.42 2644     0.45 0.65    1.87  A   7.5
WB  TH        1.11 0.57  90.0  17.45 1814    57.00 0.81   60.42  F  42.8
WB  RT        0.19 0.57  90.0   7.23  771     0.02 0.62    4.49  A   1.6
NB  LT-TH-RT  0.49 0.09  90.0  29.57  107     2.74 0.85   27.46  D   1.2
SB  LT        1.11 0.09  90.0  31.45  147   103.16 0.85  114.42  F   7.1
SB  RT        0.58 0.35  90.0  18.35  476     1.36 0.85   16.76  C   4.6

DIR Delay LOS
EB  20.00  C
WB  56.64  E
NB  27.46  D
SB  52.99  E
INTERSECTION DELAY = 39.78 INTERSECTION LOS=D

THE CYCLE LENGTH WITHIN THE BOUNDS OF  90  TO  90 SECONDS
WHICH MINIMIZES CRITICAL MOVEMENT DELAY IS  90.0 SECONDS

THE V/C RATIO CAN'T BE .95 FOR THE GIVEN CONDITIONS
THE EXISTING TIMING IS OPTIMAL
```

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CINCH PROGRAM VERSION DATE 4-29-1988
1985 HCM - CHAPTER 10 : UNSIGNALIZED - 3 APPROACHES (PAGE 1 of 2)
DATE:06-29-1991            TIME:12:51:15
BLOSSOM ST/O'CONNELL WAY - AM BUILD


LAST DATASETS LOADED OR SAVED
VOLUME=BLSMAB      GEOMETRICS=BLSM
KEY: A-  -B
        |
        C
GENERAL CHARACTERISTICS
POPULATION GREATER THAN 250,000: YES
CONTROLS: FROM C: STOP
PREVAILING SPEED:  35  MPH
MAIN STREET # OF LANES: 4 LANES
MAIN STREET APPROACH A - EXCLUSIVE RIGHT TURN LANE: N

MINOR STREET LANES
APPROACH: C: O'CONNELL
SHARED LEFT AND RIGHT TURN LANE: YES
LARGE RIGHT TURN RADIUS OR SHALLOW RIGHT TURN ANGLE: NO
RIGHT TURN ACCELERATION LANE ON MAJOR: NO


SIGHT DISTANCE RESTRICTIONS (in seconds)
APPROACH        A: BLOSSOM NB  B: BLOSSOM SB  C: O'CONNELL
LEFTS             0.00           0.00           0.00
THRUS             0.00           0.00           0.00
RIGHTS            0.00           0.00           0.00


APPROACH        A: BLOSSOM NB  B: BLOSSOM SB  C: O'CONNELL
                 LT   TH   RT   LT   TH   RT   LT   TH   RT
VOLUME            0  130   84   79  136    0   49    0  131
PHF               0.76           0.90           0.86
ADJ VOLUME        0  171  111   88  151    0   57    0  152
PERCENT GRADE     0.00           0.00           0.00
PERCENT CYCLES      0.00           0.00           0.00
PASSENGER CARS     99.00          99.00          %100.00
PERCENT LT TRU      0.00           0.00           0.00
PERCENT HV TRU      1.00           1.00           0.00
PASS CAR/HR       0              89             57    0  152


STEP 1 RIGHT TURNS FROM     C:O'CONNELL
CONFLICTING FLOWS                      141
CRITICAL GAPS                          5.2
CAPACITY                              1004
ACTUAL CAPACITY                       1004


STEP 2 LEFT TURNS FROM     B:BLOSSOM SB
CONFLICTING FLOWS                      282
CRITICAL GAPS                          5.1
CAPACITY                               883
CAPACITY USED                           10%
IMPEDANCE FACTOR                      0.94
ACTUAL CAPACITY                        883
```

```
1985 HCM - CHAPTER 10 : UNSIGNALIZED - 3 APPROACHES (PAGE 2 of 2)
DATE:06-29-1991            TIME:12:51:15
BLOSSOM ST/O'CONNELL WAY - AM BUILD


STEP 3 LEFT TURNS FROM     C:O'CONNELL
CONFLICTING FLOWS                    465
CRITICAL GAPS                        6.8
CAPACITY                             477
ACTUAL CAPACITY                      448


                    SUMMARY OF LEVEL OF SERVICE BY MOVEMENT
MOVEMENT               DEMAND    CAPACITY  RESERVE   LOS  AVG DEL(SEC) AVG QUEUE

LT FROM B:                 89        883      795     A       4.53         0.11

ALL MOVES FROM C:         209        751      541     A       6.65         0.39
```

```
CINCH PROGRAM VERSION DATE 4-29-1988
1985 HCM - CHAPTER 10: UNSIGNALIZED - 4 APPROACHES (PAGE 1 OF 2)
DATE:08-05-1991            TIME:20:51:58
BLOSSOM STREET/O'CONNELL WAY - PM BUILD W/NO MEDIAN BREAK AT GARAGE


LAST DATASETS LOADED OR SAVED
VOLUME=           GEOMETRICS=
KEY:   D
       |
    A- -B
       |
       C
GENERAL CHARACTERISTICS
POPULATION GREATER THAN 250,000: YES
CONTROLS: FROM C: STOP
          FROM D: STOP
PREVAILING SPEED:  35  MPH
MAIN STREET # OF LANES: 4 LANES
MAIN STREET APPROACH A - EXCLUSIVE RIGHT TURN LANE: NO
MAIN STREET APPROACH B - EXCLUSIVE RIGHT TURN LANE: NO

MINOR STREET LANES

APPROACH: C: NO DRIVE
EXCLUSIVE LEFT TURN LANES: NO
EXCLUSIVE RIGHT TURN LANES: NO
LARGE RIGHT TURN RADIUS OR SHALLOW RIGHT TURN ANGLE: NO
RIGHT TURN ACCELERATION LANE ON MAJOR: NO

APPROACH: D: O'CONNELL
EXCLUSIVE LEFT TURN LANES: NO
EXCLUSIVE RIGHT TURN LANES: NO
LARGE RIGHT TURN RADIUS OR SHALLOW RIGHT TURN ANGLE: NO
RIGHT TURN ACCELERATION LANE ON MAJOR: NO

SIGHT DISTANCE RESTRICTIONS (in seconds)
APPROACH         A: BLOSSOM NB  B: BLOSSOM SB  C: NO DRIVE    D: O'CONNELL
LEFTS              0.00           0.00           0.00           0.00
THRUS              0.00           0.00           0.00           0.00
RIGHTS             0.00           0.00           0.00           0.00


APPROACH         A: BLOSSOM NB  B: BLOSSOM SB  C: NO DRIVE    D: O'CONNELL
                 LT   TH   RT   LT   TH   RT   LT   TH   RT   LT   TH   RT
VOLUME             5  296  138   84  218    0    0    0    0   94    0   87
PHF                0.93           0.95           1.00           0.80
ADJ VOLUME         5  318  148   88  229    0    0    0    0  118    0  109
PERCENT GRADE      0.00           0.00           0.00
PERCENT CYCLES       0.00           0.00           0.00           0.00
PASSENGER CARS     %100.00        %100.00        %100.00        %100.00

PERCENT LT TRU       0.00           0.00           0.00           0.00
PERCENT HV TRU       0.00           0.00           0.00           0.00
PASS CAR/HR        5              88             0    0    0  118    0  109


STEP 1 RIGHT TURNS FROM     C:NO DRIVE              D:O'CONNELL
CONFLICTING FLOWS                      233                115
```

```
CRITICAL GAPS                        5.2            5.2
CAPACITY                             910           1032
CAPACITY USED                          0%            11%
IMPEDANCE FACTOR                    1.00           0.94
ACTUAL CAPACITY                      910           1032
```

```
1985 HCM - CHAPTER 10: UNSIGNALIZED - 4 APPROACHES (PAGE 2 OF 2)
DATE:08-05-1991           TIME:20:51:58
BLOSSOM STREET/O'CONNELL WAY - PM BUILD W/NO MEDIAN BREAK AT GARAGE

STEP 2 LEFT TURNS FROM     B:BLOSSOM SB            A:BLOSSOM NB
CONFLICTING FLOWS                    467                    229
CRITICAL GAPS                        5.6                    5.6
CAPACITY                             635                    842
CAPACITY USED                         14%                     1%
IMPEDANCE FACTOR                    0.91                   1.00
ACTUAL CAPACITY                      635                    842


STEP 3 THRU MOVES FROM     C:NO DRIVE  .           D:O'CONNELL
CONFLICTING FLOWS                    716                    790
CRITICAL GAPS                        6.8                    6.8
CAPACITY                             326                    290
CAPACITY USED                          0%                     0%
IMPEDANCE FACTOR                    1.00                   1.00
ACTUAL CAPACITY                      295                    263


STEP 4 LEFT TURNS FROM     C:NO DRIVE              D:O'CONNELL
CONFLICTING FLOWS                    824                    790
CRITICAL GAPS                        7.3                    7.3
CAPACITY                             235                    250
ACTUAL CAPACITY                      200                    227


                    SUMMARY OF LEVEL OF SERVICE BY MOVEMENT
MOVEMENT                 DEMAND    CAPACITY  RESERVE   LOS  AVG DEL(SEC) AVG QUEUE

LT FROM A:                    5       842       837     A      4.30          0.01
LT FROM B:                   88       635       546     A      6.59          0.16


ALL MOVES FROM D:           226       363       136     D     26.42          1.66
```

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CINCH PROGRAM VERSION DATE 4-29-1988
1985 HCM - CHAPTER 10: UNSIGNALIZED - 4 APPROACHES (PAGE 1 OF 2)
DATE:08-05-1991             TIME:20:52:48
BLOSSOM STREET/O'CONNELL WAY - PM BUILD W/MEDIAN BREAK AT GARAGE


LAST DATASETS LOADED OR SAVED
VOLUME=            GEOMETRICS=
KEY:   D
       |
    A-  -B
       |
       C
GENERAL CHARACTERISTICS
POPULATION GREATER THAN 250,000: YES
CONTROLS: FROM C: STOP
          FROM D: STOP
PREVAILING SPEED:  35  MPH
MAIN STREET # OF LANES: 4 LANES
MAIN STREET APPROACH A - EXCLUSIVE RIGHT TURN LANE: NO
MAIN STREET APPROACH B - EXCLUSIVE RIGHT TURN LANE: NO

MINOR STREET LANES

APPROACH: C: NO DRIVE
EXCLUSIVE LEFT TURN LANES: NO
EXCLUSIVE RIGHT TURN LANES: NO
LARGE RIGHT TURN RADIUS OR SHALLOW RIGHT TURN ANGLE: NO
RIGHT TURN ACCELERATION LANE ON MAJOR: NO

APPROACH: D: O'CONNELL
EXCLUSIVE LEFT TURN LANES: NO
EXCLUSIVE RIGHT TURN LANES: NO
LARGE RIGHT TURN RADIUS OR SHALLOW RIGHT TURN ANGLE: NO
RIGHT TURN ACCELERATION LANE ON MAJOR: NO

SIGHT DISTANCE RESTRICTIONS (in seconds)
APPROACH        A: BLOSSOM NB  B: BLOSSOM SB  C: NO DRIVE    D: O'CONNELL
LEFTS             0.00           0.00           0.00           0.00
THRUS             0.00           0.00           0.00           0.00
RIGHTS            0.00           0.00           0.00           0.00


APPROACH        A: BLOSSOM NB  B: BLOSSOM SB  C: NO DRIVE    D: O'CONNELL
                 LT   TH   RT   LT   TH   RT   LT   TH   RT   LT   TH   RT
VOLUME            0  296  138   84  218    0    0    0    0   94    0   87
PHF               0.93           0.95           1.00           0.80
ADJ VOLUME        0  318  148   88  229    0    0    0    0  118    0  109
PERCENT GRADE     0.00           0.00           0.00
PERCENT CYCLES      0.00           0.00           0.00           0.00
PASSENGER CARS     %100.00        %100.00        %100.00        %100.00

PERCENT LT TRU      0.00           0.00           0.00           0.00
PERCENT HV TRU      0.00           0.00           0.00           0.00
PASS CAR/HR       0              88             0    0    0  118    0  109


STEP 1 RIGHT TURNS FROM     C:NO DRIVE              D:O'CONNELL
CONFLICTING FLOWS                      233                115
```

```
CRITICAL GAPS                         5.2             5.2
CAPACITY                              910            1032
CAPACITY USED                          0%             11%
IMPEDANCE FACTOR                     1.00            0.94
ACTUAL CAPACITY                       910            1032
```

```
1985 HCM - CHAPTER 10: UNSIGNALIZED - 4 APPROACHES (PAGE 2 OF 2)
DATE:08-05-1991            TIME:20:52:48
BLOSSOM STREET/O'CONNELL WAY - PM BUILD W/MEDIAN BREAK AT GARAGE

STEP 2 LEFT TURNS FROM      B:BLOSSOM SB              A:BLOSSOM NB
CONFLICTING FLOWS                       467                    229
CRITICAL GAPS                           5.6                    5.6
CAPACITY                                635                    842
CAPACITY USED                            14%                     0%
IMPEDANCE FACTOR                       0.91                   1.00
ACTUAL CAPACITY                         635                    842


STEP 3 THRU MOVES FROM      C:NO DRIVE                D:O'CONNELL
CONFLICTING FLOWS                       710                    785
CRITICAL GAPS                           6.8                    6.8
CAPACITY                                328                    292
CAPACITY USED                             0%                     0%
IMPEDANCE FACTOR                       1.00                   1.00
ACTUAL CAPACITY                         299                    266


STEP 4 LEFT TURNS FROM      C:NO DRIVE                D:O'CONNELL
CONFLICTING FLOWS                       819                    785
CRITICAL GAPS                           7.3                    7.3
CAPACITY                                238                    252
ACTUAL CAPACITY                         202                    229


                         SUMMARY OF LEVEL OF SERVICE BY MOVEMENT
MOVEMENT                   DEMAND     CAPACITY  RESERVE   LOS  AVG DEL(SEC) AVG QUEUE

LT FROM B:                    88         635       546     A      6.59          0.16


ALL MOVES FROM D:            226         366       140     D     25.77          1.62
```

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CINCH PROGRAM VERSION DATE 4-29-1988
1985 HCM - CHAPTER 10: UNSIGNALIZED - 4 APPROACHES (PAGE 1 OF 2)
DATE:08-05-1991            TIME:20:34:54
STANDIFORD ST/O'CONNELL WAY - AM BUILD


LAST DATASETS LOADED OR SAVED
VOLUME=           GEOMETRICS=
KEY:   D
       |
     A- -B
       |
       C
GENERAL CHARACTERISTICS
POPULATION GREATER THAN 250,000: NO
CONTROLS: FROM C: STOP
          FROM D: STOP
PREVAILING SPEED:  35  MPH
MAIN STREET # OF LANES: 4 LANES
MAIN STREET APPROACH A - EXCLUSIVE RIGHT TURN LANE: NO
MAIN STREET APPROACH B - EXCLUSIVE RIGHT TURN LANE: NO

MINOR STREET LANES

APPROACH: C: O'CONNELL
EXCLUSIVE LEFT TURN LANES: NO
EXCLUSIVE RIGHT TURN LANES: NO
LARGE RIGHT TURN RADIUS OR SHALLOW RIGHT TURN ANGLE: NO
RIGHT TURN ACCELERATION LANE ON MAJOR: NO

APPROACH: D: DRIVE
EXCLUSIVE LEFT TURN LANES: NO
EXCLUSIVE RIGHT TURN LANES: NO
LARGE RIGHT TURN RADIUS OR SHALLOW RIGHT TURN ANGLE: NO
RIGHT TURN ACCELERATION LANE ON MAJOR: NO

[illegible]
APPROACH        A: STANIFORD N B: STANIFORD S C: O'CONNELL   D: DRIVE
LEFTS             0.00           0.00           0.00           0.00
THRUS             0.00           0.00           0.00           0.00
RIGHTS            0.00           0.00           0.00           0.00


APPROACH        A: STANIFORD N B: STANIFORD S C: O'CONNELL   D: DRIVE
                 LT   TH   RT   LT   TH   RT   LT   TH   RT   LT   TH   RT
VOLUME           61  413    1    8  367  152   99    0   21    0    0    0
PHF               0.88           0.94           0.85           1.00
ADJ VOLUME       69  469    1    9  390  162  116    0   25    0    0    0
PERCENT GRADE     0.00           0.00           0.00
PERCENT CYCLES     0.00           0.00           0.00           0.00
PASSENGER CARS    98.00          97.00          96.00         %100.00
PERCENT LT TRU     0.00           0.00           0.00           0.00
PERCENT HV TRU     2.00           3.00           4.00           0.00
PASS CAR/HR      71              9             121    0   26    0    0    0


STEP 1 RIGHT TURNS FROM     C:O'CONNELL             D:DRIVE
CONFLICTING FLOWS                     235                 276
CRITICAL GAPS                         5.7                 5.7
```

CAPACITY	820	781
CAPACITY USED	3%	0%
IMPEDANCE FACTOR	0.98	1.00
ACTUAL CAPACITY	820	781

```
1985 HCM - CHAPTER 10: UNSIGNALIZED - 4 APPROACHES (PAGE 2 OF 2)
DATE:08-05-1991           TIME:20:34:54
STANDIFORD ST/O'CONNELL WAY - AM BUILD

STEP 2 LEFT TURNS FROM     B:STANIFORD S           A:STANIFORD NB
CONFLICTING FLOWS                     470                 552
CRITICAL GAPS                         5.6                 5.6
CAPACITY                              632                 571
CAPACITY USED                          1%                 12%
IMPEDANCE FACTOR                     0.99                0.92
ACTUAL CAPACITY                       632                 571


STEP 3 THRU MOVES FROM     C:O'CONNELL .           D:DRIVE
CONFLICTING FLOWS                    1100                1020
CRITICAL GAPS                         6.8                 6.8
CAPACITY                              174                 199
CAPACITY USED                          0%                  0%
IMPEDANCE FACTOR                     1.00                1.00
ACTUAL CAPACITY                       159                 182


STEP 4 LEFT TURNS FROM     C:O'CONNELL             D:DRIVE
CONFLICTING FLOWS                    1100                1044
CRITICAL GAPS                         7.3                 7.3
CAPACITY                              145                 160
ACTUAL CAPACITY                       132                 144


                     SUMMARY OF LEVEL OF SERVICE BY MOVEMENT
MOVEMENT                DEMAND    CAPACITY  RESERVE   LOS  AVG DEL(SEC) AVG QUEUE

LT FROM A:                 71        571       500     A       7.20         0.14
LT FROM B:                  9        632       623     A       5.78         0.01

ALL MOVES FROM C:         147        155         8     F     426.59        17.40
```

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CINCH PROGRAM VERSION DATE 4-29-1988
1985 HCM - CHAPTER 10: UNSIGNALIZED - 4 APPROACHES (PAGE 1 OF 2)
DATE:07-12-1991             TIME:13:33:46
STANIFROD ST/O'CONNELL WAY - PM BUILD


LAST DATASETS LOADED OR SAVED
VOLUME=STNFDPB    GEOMETRICS=STNFRD
KEY:   D
       |
     A- -B
       |
       C
GENERAL CHARACTERISTICS
POPULATION GREATER THAN 250,000: YES
CONTROLS: FROM C: STOP
          FROM D: YIELD
PREVAILING SPEED:  35  MPH
MAIN STREET # OF LANES: 4 LANES
MAIN STREET APPROACH A - EXCLUSIVE RIGHT TURN LANE: NO
MAIN STREET APPROACH B - EXCLUSIVE RIGHT TURN LANE: NO

MINOR STREET LANES

APPROACH: C: O'CONNELL WAY
EXCLUSIVE LEFT TURN LANES: NO
EXCLUSIVE RIGHT TURN LANES: NO
LARGE RIGHT TURN RADIUS OR SHALLOW RIGHT TURN ANGLE: NO
RIGHT TURN ACCELERATION LANE ON MAJOR: NO

APPROACH: D:
EXCLUSIVE LEFT TURN LANES: NO
EXCLUSIVE RIGHT TURN LANES: NO
LARGE RIGHT TURN RADIUS OR SHALLOW RIGHT TURN ANGLE: NO
RIGHT TURN ACCELERATION LANE ON MAJOR: NO

SIGHT DISTANCE RESTRICTIONS (in seconds)
APPROACH        A: STANIFORD N B: STANIFORD S C: O'CONNELL W D:
LEFTS             0.00           0.00           0.00           0.00
THRUS             0.00           0.00           0.00           0.00
RIGHTS            0.00           0.00           0.00           0.00


APPROACH        A: STANIFORD N B: STANIFORD S C: O'CONNELL W D:
                 LT   TH   RT   LT   TH   RT   LT   TH   RT   LT   TH   RT
VOLUME           65  507    0    6  405   94  194    0   13    0    0    0
PHF               0.89           0.87           0.84           1.00
ADJ VOLUME       73  570    0    7  466  108  231    0   15    0    0    0
PERCENT GRADE     0.00           0.00           0.00
PERCENT CYCLES      0.00           0.00           0.00           0.00
PASSENGER CARS     99.00          99.00          99.00           0.00
PERCENT LT TRU      0.00           0.00           0.00           0.00
PERCENT HV TRU      1.00           1.00           1.00           0.00
PASS CAR/HR      74              7             233    0   16    0    0    0


STEP 1 RIGHT TURNS FROM     C:O'CONNELL WAY          D:
CONFLICTING FLOWS                      285                 287
CRITICAL GAPS                          5.2                 4.6
```

```
CAPACITY                                861                986
CAPACITY USED                             2%                 0%
IMPEDANCE FACTOR                       0.99               1.00
ACTUAL CAPACITY                         861                986
```

```
1985 HCM - CHAPTER 10: UNSIGNALIZED - 4 APPROACHES (PAGE 2 OF 2)
DATE:07-12-1991            TIME:13:33:46
STANIFROD ST/O'CONNELL WAY - PM BUILD

STEP 2 LEFT TURNS FROM      B:STANIFORD SB            A:STANIFORD NB
CONFLICTING FLOWS                      570                       574
CRITICAL GAPS                          5.6                       5.6
CAPACITY                               559                       556
CAPACITY USED                           1%                        13%
IMPEDANCE FACTOR                      1.00                      0.91
ACTUAL CAPACITY                        559                       556


STEP 3 THRU MOVES FROM      C:O'CONNELL WAY           D:
CONFLICTING FLOWS                     1223                      1169
CRITICAL GAPS                          6.8                       6.2
CAPACITY                               141                       195
CAPACITY USED                           0%                        0%
IMPEDANCE FACTOR                      1.00                      1.00
ACTUAL CAPACITY                        128                       178


STEP 4 LEFT TURNS FROM      C:O'CONNELL WAY           D:
CONFLICTING FLOWS                     1223                      1185
CRITICAL GAPS                          7.3                       6.7
CAPACITY                               115                       156
ACTUAL CAPACITY                        105                       141


                        SUMMARY OF LEVEL OF SERVICE BY MOVEMENT
MOVEMENT                   DEMAND    CAPACITY  RESERVE   LOS  AVG DEL(SEC) AVG QUEUE

LT FROM A:                   74        556       482      A      7.47         0.15
LT FROM B:                    7        559       552      A      6.53         0.01

ALL MOVES FROM C:           249        111      -138      F   INFINITE     INFINITE
```

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CINCH PROGRAM VERSION DATE 4-29-1988
1985 HCM - CHAPTER 9: SIGNALIZED - OPERATIONAL ANALYSIS
CAMBRIDGE ST/STANIFORD ST/TEMPLE STREET
AM BUILD
date:08-12-1991            time:06:31:25
LAST DATA SET NAMES LOADED OR SAVED
VOLUME=            GEOMETRICS=           SIGNAL=
LOCATED IN CBD:Y
VOLUME & GEOMETRICS
        VOLUMES       # OF LANES     LANE WIDTH     CROSS
DIR  LT   TH   RT     LT TH RT      LT   TH   RT    WALK
EB  309 1039    0      1  2  0    11.0 11.0  0.0     0
WB    0  883  139      0  2  0     0.0 12.0  0.0     0
NB    1    3    1      0  1  0     0.0 12.0  0.0     0
SB  170    0  295      1  0  1    12.0  0.0 12.0     0

TRAFFIC & ROADWAY CONDITIONS
                 ADJ PARK                PEDESTRIANS       ARR
DIR GRADE %HV   Y/N MOVES BUSES  PHF CROSS BUT MIN TIME TYPE
EB  0.0%  1.0%        0     0   .800   0          7.0    4
WB  0.0%  1.0%        0     0   .880   0          7.0    4
NB  0.0%  0.0%        0     0   .420   0          7.0    3
SB  0.0%  1.0%        0     0   .870   0          7.0    3

PHASINGS
    EASTBOUND   WESTBOUND   NORTHBOUND  SOUTHBOUND GREEN  Y+R PRE/ACT
    l  t  r  p  l  t  r  p  l  t  r  p  l  t  r  p
 1     *           *  *                              39.2   4    A
 2  *  *                                      *      26.5   4    A
 3                          *  *  *     *     *      12.3   4    A

CYCLE=  90.0

VOLUME ADJUSTMENT WORKSHEET
PART 1 (MOVEMENT ADJUSTMENTS)
DIR  LTV  THV  RTV   PHF   LTFR THFR RTFR
EB   309 1039    0  .800    386 1299    0
       0  883  139  .880      0 1003  158
NB     1    3    1  .420      2    7    2
SB   170    0  295  .870    195    0  339

PART 2 (LANE GROUP ADJUSTMENTS)
DIR LN GROUP   FLOW N   LU     v  Plt  Prt
EB  LT          386 1 1.00   386 1.00 0.00
EB  TH         1299 2 1.05  1364 0.00 0.00
WB  TH-RT      1161 2 1.05  1219 0.00 0.14
NB  LT-TH-RT     12 1 1.00    12 0.20 0.20
SB  LT          195 1 1.00   195 1.00 0.00
SB  RT          339 1 1.00   339 0.00 1.00

PART 3 (OPPOSING VOLUME ADJUSTMENTS)
LEFT TURN                  OPPOSING APPROACH
BEING OPPOSED        VOLUMES       % OPPOSING LEFT TURN      # LANES     OPPOSING
                   LT   TH   RT       LT    TH    RT        LT  TH  RT    VOLUME
EASTBOUND           0 1003  158        0     0     0         0   2   0       0
NORTHBOUND        195    0  339      100     0     0         1   0   1       0
SOUTHBOUND          2    7    2      100   100   100         0   1   0      10

SATURATION FLOW ADJUSTMENT WORKSHEET
```

```
DIR LN GROUP  IDEAL N  Fwid   Fhv    Fgr Fpark  Fbus Farea   Frt   Flt    s
EB  LT         1800  1 0.967 0.995 1.000 1.000 1.000 0.900 1.000 0.950 1480
EB  TH         1800  2 0.967 0.995 1.000 1.000 1.000 0.900 1.000 1.000 3116
WB  TH-RT      1800  2 1.000 0.995 1.000 1.000 1.000 0.900 0.980 1.000 3158
NB  LT-TH-RT   1800  1 1.000 1.000 1.000 1.000 1.000 0.900 0.873 0.873 1235
SB  LT         1800  1 1.000 0.995 1.000 1.000 1.000 0.900 1.000 1.000 1612
SB  RT         1800  1 1.000 0.995 1.000 1.000 1.000 0.900 0.850 1.000 1370

SUPPLEMENTAL WORKSHEET FOR LEFT-TURN ADJUSTMENT FACTOR FLT
INPUT VARIABLES
DIR  C   G  N   Va   Vm  Vlt  Plt No   Vo Plto
SB  90  12  1  195  339  195 1.00  1   10 0.20
CALCULATIONS
OIR Sop    Yo     Gu    Fs    Pl     Gq    Pt    Gf       El    Fm   Flt
SB 1580 0.006 11.836 0.869 1.000  0.471 0.000  0.000    1.295 1.000 1.000

CAPACITY ANALYSIS WORKSHEET
DIR LN GROUP     v     s  v/s  g/C    c  v/c  CRITICAL
EB  LT         386  1480 0.26 0.29  436 0.89     *
EB  TH        1364  3116 0.44 0.77 2413 0.57
WB  TH-RT     1219  3158 0.39 0.44 1376 0.89     *
NB  LT-TH-RT    12  1235 0.01 0.14  169 0.07
SB  LT         195  1612 0.12 0.14  220 0.89     *
SB  RT         339  1370 0.25 0.48  652 0.52

CYCLE= 90.0  LOST=12.0  SUM V/S CRIT= 0.77 TOTAL V/C= 0.89

LEVEL OF SERVICE WORKSHEET
DIR LN GROUP  v/c  g/C   C     d1    c       d2   PF   Oelay LOS Avg Q  95% Q
EB  LT        0.89 0.29  90.0  23.04  436   13.55 1.00  36.59  D    7.3
EB  TH        0.57 0.77  90.0   3.10 2413    0.24 0.62   2.07  A    7.3
WB  TH-RT     0.89 0.44  90.0  17.75 1376    5.27 0.74  17.10  C   16.4
NB  LT-TH-RT  0.07 0.14  90.0  25.73  169    0.00 0.85  21.88  C    0.3
SB  LT        0.89 0.14  90.0  29.00  220   22.35 0.85  43.65  E    4.5
SB  RT        0.52 0.48  90.0  12.50  652    0.62 0.85  11.15  B    4.4

DIR Delay LOS
EB   9.69  B
WB  17.10  C
NB  21.88  C
SB  23.03  C
INTERSECTION DELAY = 14.33 INTERSECTION LOS=B

THE CYCLE LENGTH WITHIN THE BOUNDS OF  90  TO  90 SECONDS
WHICH MINIMIZES CRITICAL MOVEMENT DELAY IS  90.0 SECONDS

FOR A V/C RATIO OF .95 THE CYCLE SHOULD BE  62.7 SECONDS
THE EXISTING TIMING IS OPTIMAL
```

```
CINCH PROGRAM VERSION DATE 4-29-1988
1985 HCM - CHAPTER 9: SIGNALIZED - OPERATIONAL ANALYSIS
CAMBRIDGE ST/STANIFORD ST/TEMPLE STREET
PM BUILD
date:08-12-1991             time:06:24:58
LAST DATA SET NAMES LOADED OR SAVED
VOLUME=           GEOMETRICS=           SIGNAL=
LOCATED IN CBD:Y
VOLUME & GEOMETRICS
        VOLUMES      # OF LANES     LANE WIDTH     CROSS
DIR  LT   TH   RT    LT TH RT      LT   TH    RT    WALK
EB  493  848    0     1  2  0    11.0 11.0  0.0     0
WB    0  967  337     0  2  0     0.0 12.0  0.0     0
NB    2    0    0     0  1  0     0.0 12.0  0.0     0
SB  220    0  311     1  0  1    12.0  0.0 12.0     0

TRAFFIC & ROADWAY CONDITIONS
                 ADJ PARK             PEDESTRIANS        ARR
DIR GRADE %HV   Y/N MOVES BUSES  PHF CROSS BUT MIN TIME TYPE
EB  0.0%  0.0%         0    0  .870    0         7.0    4
WB  0.0%  1.0%         0    0  .910    0         7.0    4
NB  0.0%  0.0%         0    0  .500    0         7.0    3
SB  0.0%  1.0%         0    0  .930    0         7.0    3

PHASINGS
    EASTBOUND   WESTBOUND   NORTHBOUND  SOUTHBOUND GREEN  Y+R PRE/ACT
    l  t  r  p  l  t  r  p  l  t  r  p  l  t  r  p
 1     *           *  *                             41.9   4    A
 2  *  *                                      *     32.8   4    A
 3                          *  *  *     *     *     13.3   4    A

CYCLE= 100.0

VOLUME ADJUSTMENT WORKSHEET
PART 1 (MOVEMENT ADJUSTMENTS)
DIR  LTV  THV  RTV   PHF  LTFR THFR RTFR
EB   493  848    0  .870   567  975    0

NB     2    0    0  .500     4    0    0
SB   220    0  311  .930   237    0  334

PART 2 (LANE GROUP ADJUSTMENTS)
DIR LN GROUP  FLOW N   LU     v  Plt  Prt
EB  LT          567 1 1.00  567 1.00 0.00
EB  TH          975 2 1.05 1023 0.00 0.00
WB  TH-RT      1433 2 1.05 1505 0.00 0.26
NB  LT            4 0 0.00    0 1.00 0.00
NB  LT-TH         4 1 1.00    4 1.00 0.00
SB  LT          237 1 1.00  237 1.00 0.00
SB  RT          334 1 1.00  334 0.00 1.00

PART 3 (OPPOSING VOLUME ADJUSTMENTS)
LEFT TURN                OPPOSING APPROACH
BEING OPPOSED       VOLUMES      % OPPOSING LEFT TURN    # LANES     OPPOSING
                 LT   TH   RT        LT   TH   RT        LT  TH  RT      VOLUME
EASTBOUND         0 1063  370         0    0    0         0   2   0       0
NORTHBOUND      237    0  334       100    0    0         1   0   1       0
SOUTHBOUND        4    0    0       100  100  100         0   1   0       0
```

```
SATURATION FLOW ADJUSTMENT WORKSHEET
DIR LN GROUP  IDEAL N  Fwid   Fhv   Fgr  Fpark  Fbus  Farea   Frt   Flt    s
EB  LT         1800  1 0.967 1.000 1.000 1.000 1.000 0.900 1.000 0.950 1488
EB  TH         1800  2 0.967 1.000 1.000 1.000 1.000 0.900 1.000 1.000 3132
WB  TH-RT      1800  2 1.000 0.995 1.000 1.000 1.000 0.900 0.961 1.000 3099
NB  LT         1800  0 0.600 1.000 1.000 1.000 1.000 0.900 1.000 0.000    0
NB  LT-TH      1800  1 1.000 1.000 1.000 1.000 1.000 0.900 1.000 0.765 1239
SB  LT         1800  1 1.000 0.995 1.000 1.000 1.000 0.900 1.000 0.950 1531
SB  RT         1800  1 1.000 0.995 1.000 1.000 1.000 0.900 0.850 1.000 1370

CAPACITY ANALYSIS WORKSHEET
DIR LN GROUP     v     s  v/s  g/C     c  v/c  CRITICAL
EB  LT         567  1488 0.38 0.33   488 1.16     *
EB  TH        1023  3132 0.33 0.79  2464 0.42
WB  TH-RT     1505  3099 0.49 0.42  1297 1.16     *
NB  LT           0     0 0.00 0.13     0 0.00
NB  LT-TH        4  1239 0.00 0.13   165 0.02
SB  LT         237  1531 0.15 0.13   204 1.16     *
SB  RT         334  1370 0.24 0.50   687 0.49

CYCLE=100.0  LOST=12.0  SUM V/S CRIT= 1.02 TOTAL V/C= 1.16

LEVEL OF SERVICE WORKSHEET
DIR LN GROUP  v/c  g/C    C     d1     c      d2   PF   Delay LOS Avg Q  95% Q
EB  LT       1.16 0.33 100.0  27.69  488   96.02 1.00  123.71  F   24.8
EB  TH       0.42 0.79 100.0   2.56 2464    0.07 0.62    1.63  A    5.8
WB  TH-RT    1.16 0.42 100.0  24.97 1297   83.82 0.82   89.58  F   47.2
NB  LT       0.00 0.13 100.0   0.00    0    0.00 1.00    0.00  A    0.1
NB  LT-TH    0.02 0.13 100.0  28.65  165    0.00 0.85   24.35  C    0.1
SB  LT       1.16 0.13 100.0  33.77  204  116.81 0.85  128.00  F   11.3
SB  RT       0.49 0.50 100.0  12.49  687    0.45 0.85   11.00  B    4.6

DIR Delay LOS
EB  45.14  E
WB  89.58  F
NB  24.35  C
SB  59.47  E
INTERSECTION DELAY = 65.57 INTERSECTION LOS=F

THE CYCLE LENGTH WITHIN THE BOUNDS OF  100  TO  100 SECONDS
WHICH MINIMIZES CRITICAL MOVEMENT DELAY IS 100.0 SECONDS

THE V/C RATIO CAN'T BE .95 FOR THE GIVEN CONDITIONS
THE EXISTING TIMING IS OPTIMAL
```

```
CINCH PROGRAM VERSION DATE 4-29-1988
1985 HCM - CHAPTER 10 : UNSIGNALIZED - 3 APPROACHES (PAGE 1 of 2)
DATE:07-15-1991             TIME:15:45:00
GARAGE/BLOSSOM - NO MEDIAN AM


LAST DATASETS LOADED OR SAVED
VOLUME=DRIVEA     GEOMETRICS=DRIVE
KEY: A- -B
       |
       C
GENERAL CHARACTERISTICS
POPULATION GREATER THAN 250,000: YES
CONTROLS: FROM C: STOP
PREVAILING SPEED:  35  MPH
MAIN STREET # OF LANES: 4 LANES
MAIN STREET APPROACH A - EXCLUSIVE RIGHT TURN LANE: N

MINOR STREET LANES
APPROACH: C: DRIVE
SHARED LEFT AND RIGHT TURN LANE: YES
LARGE RIGHT TURN RADIUS OR SHALLOW RIGHT TURN ANGLE: NO
RIGHT TURN ACCELERATION LANE ON MAJOR: NO


SIGHT DISTANCE RESTRICTIONS (in seconds)
APPROACH        A: BLOSSOM ST  B: BLOSSOM SB  C: DRIVE
LEFTS             0.00           0.00           0.00
THRUS             0.00           0.00           0.00
RIGHTS            0.00           0.00           0.00


APPROACH        A: BLOSSOM ST  B: BLOSSOM SB  C: DRIVE
                 LT   TH   RT   LT   TH   RT   LT   TH   RT
VOLUME            0  214   21    0  185    0    0    0    0
PHF              0.90           0.90           0.90
ADJ VOLUME        0  238   23    0  206    0    0    0    0
PERCENT GRADE    0.00           0.00           0.00
PERCENT CYCLES     0.00           0.00           0.00
PASSENGER CARS    99.00          99.00         %100.00
PERCENT LT TRU     0.00           0.00           0.00
PERCENT HV TRU     1.00           1.00           0.00
PASS CAR/HR       0              0              0    0    0


STEP 1 RIGHT TURNS FROM     C:DRIVE
CONFLICTING FLOWS                      131
CRITICAL GAPS                          5.2
CAPACITY                              1015
ACTUAL CAPACITY                       1015


STEP 2 LEFT TURNS FROM     B:BLOSSOM SB
CONFLICTING FLOWS                      261
CRITICAL GAPS                          5.1
CAPACITY                               903
CAPACITY USED                           0%
IMPEDANCE FACTOR                      1.00
ACTUAL CAPACITY                        903
```

```
1985 HCM - CHAPTER 10 : UNSIGNALIZED - 3 APPROACHES (PAGE 2 of 2)
DATE:07-15-1991            TIME:15:45:00
GARAGE/BLOSSOM - NO MEDIAN AM


STEP 3 LEFT TURNS FROM     C:DRIVE
CONFLICTING FLOWS                  455
CRITICAL GAPS                      6.8
CAPACITY                           485
ACTUAL CAPACITY                    485


                    SUMMARY OF LEVEL OF SERVICE BY MOVEMENT
MOVEMENT                 DEMAND    CAPACITY  RESERVE   LOS  AVG DEL(SEC) AVG QUEUE
```

```
CINCH PROGRAM VERSION DATE 4-29-1988
1985 HCM - CHAPTER 10 : UNSIGNALIZED - 3 APPROACHES (PAGE 1 of 2)
DATE:07-15-1991             TIME:15:47:16
GARAGE - PM WITHOUT MEDIAN BREAK


LAST DATASETS LOADED OR SAVED
VOLUME=DRIVEP     GEOMETRICS=DRIVE
KEY: A- -B
       |
       C
GENERAL CHARACTERISTICS
POPULATION GREATER THAN 250,000: YES
CONTROLS: FROM C: STOP
PREVAILING SPEED:  35  MPH
MAIN STREET # OF LANES: 4 LANES
MAIN STREET APPROACH A - EXCLUSIVE RIGHT TURN LANE: N

MINOR STREET LANES
APPROACH: C: DRIVE
SHARED LEFT AND RIGHT TURN LANE: YES
LARGE RIGHT TURN RADIUS OR SHALLOW RIGHT TURN ANGLE: NO
RIGHT TURN ACCELERATION LANE ON MAJOR: NO


SIGHT DISTANCE RESTRICTIONS (in seconds)
APPROACH        A: BLOSSOM ST  B: BLOSSOM SB  C: DRIVE
LEFTS             0.00           0.00           0.00
THRUS             0.00           0.00           0.00
RIGHTS            0.00           0.00           0.00


APPROACH        A: BLOSSOM ST  B: BLOSSOM SB  C: DRIVE
                 LT   TH   RT   LT   TH   RT   LT   TH   RT
VOLUME            0  426    3    0  312    0    0    0   13
PHF              0.90           0.90           0.90
ADJ VOLUME        0  473    3    0  347    0    0    0   14
PERCENT GRADE    0.00           0.00           0.00
PERCENT CYCLES     0.00           0.00           0.00
PASSENGER CARS    99.00          99.00          %100.00
PERCENT LT TRU     0.00           0.00           0.00
PERCENT HV TRU     1.00           1.00           0.00
PASS CAR/HR       0              0              0    0   14


STEP 1 RIGHT TURNS FROM     C:DRIVE
CONFLICTING FLOWS                      238
CRITICAL GAPS                          5.2
CAPACITY                               905
ACTUAL CAPACITY                        905


STEP 2 LEFT TURNS FROM     B:BLOSSOM SB
CONFLICTING FLOWS                      477
CRITICAL GAPS                          5.1
CAPACITY                               714
CAPACITY USED                            0%
IMPEDANCE FACTOR                      1.00
ACTUAL CAPACITY                        714
```

```
1985 HCM - CHAPTER 10 : UNSIGNALIZED - 3 APPROACHES (PAGE 2 of 2)
DATE:07-15-1991             TIME:15:47:16
GARAGE - PM WITHOUT MEDIAN BREAK


STEP 3 LEFT TURNS FROM     C:DRIVE
CONFLICTING FLOWS                       822
CRITICAL GAPS                           6.8
CAPACITY                                275
ACTUAL CAPACITY                         275


                    SUMMARY OF LEVEL OF SERVICE BY MOVEMENT
MOVEMENT               DEMAND     CAPACITY  RESERVE   LOS  AVG DEL(SEC) AVG QUEUE


ALL MOVES FROM C:          14        905       891     A      4.04         0.02
```

Appendix B3

Parking Field Survey Sheets

B TON
TRANSPORTATION
DEPARTMENT

[illegible]
BOSTON, MASSACHUSETTS 02201
[illegible]

DATE: July 12, 1991

TO: Barry Porter, H.W. Moore
FROM: Andrew McClurg
RE: Public parking availability in the area of Shriner's Institute

---

As we discussed, the BTD has recently finished conducting a survey of public parking facilities in the downtown area, with regard to rates charged and occupancy. I have reviewed the data, and can pass on to you the following aggregate information, pertaining to the area described by Cambridge St., Staniford St., Lomasney Way and Storrow Drive.

Within the are are 11 public parking facilities, 5 lots and 6 garages, containing a total of 4083 spaces. Of these, 3983 are licensed by the Boston Air Pollution Control Commission; the other 100 are unlicensed.

The occupancy of the spaces totals 3110 at 9:00 AM, 3514 at 12:00 noon, and 3481 at 2:00 PM. This means that the peak occupancy is 86%, with a surplus of 569 public spaces.

5094T

RAYMOND L. FLYNN, MAYOR
RICHARD A. DIMINO, COMMISSIONER

LICENSE PLATE CHECK FIELD DATA SHEET

City______ Date 10/2/91 Recorded by BK Side of Street______

Street Blossom between Storrow and Cambridge

Codes: 000 last three digits of license number; √ for repeat number from prior circuit; _for empty space

Space and Regulation	Time circuit begins											
	11	11:20	11:40	12:00	12:20	12:40	1:00	1:20	1:40	2:00	2:20	
1	728	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
2	KYE	✓	HDH	✓	✓	✓	✓	✓	NDO	✓	✓	
3	9IM	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
4	NJP	✓	LBI	✓	✓	✓	STB	✓	003	312 [illegible]	✓	
5	TBI	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
6	957	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
7	750	✓	✓	✓	✓	✓	22C	✓	✓	✓	LLH	
8	EEI	✓	✓	✓	✓	✓	ASh	✓	✓	✓	VXW	
9	D90	✓	✓	✓	✓	IRR	✓	✓	✓	✓	✓	
10	792	✓	✓	✓	✓	✓	✓	✓	C53	AFB	✓	
11	PPV	✓	R6K	✓	✓	VMD	✓	✓	712	PRZ	✓	
12	56R	✓	✓	✓	✓	✓	✓	✓	✓	✓	FWH	
13	RSF	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
14	KBY	VXT	✓	✓	✓	✓	✓	✓	✓	✓	✓	
15	HBT	✓	VAT	TQ	✓	✓	✓	✓	✓	✓	✓	
16	PYP	✓	TWP	✓	✓	✓	✓	✓	✓	✓	✓	
17	PLZ	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
18	SPM	✓	✓	✓	✓	BMT	✓	✓	✓	RBL	✓	

City________ Date________ Recorded by________ Side of Street________

Street________ between________ and________

Codes: 000 last three digits of license number; ✓ for repeat number from prior circuit; _ for empty space

Space and Regulation	Time circuit begins										
	11.00	11:20	11:40	12:00	12:20	12:40	1:00	1:20	1:40	2:00	2:20
19	055	✓	161	✓	✓	✓	✓	—	✓	—	—
20	Van	✓	✓	✓	✓	✓	✓	—	✓	✓	✓
21	59C	137	✓	✓	✓	✓	✓	—	—	✓	✓
22	VTG	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
23	AVV	✓	✓	6CC	✓	✓	✓	✓	✓	✓	✓
24	CDL	N46	✓	✓	✓	TGH	✓	✓	POG	✓	✓
25	522	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
26	DXT	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
27	306	✓	✓	✓	✓	✓	✓	—	094	2	✓
28	KWS	✓	✓	PKS	✓	104	✓	✓	✓	—	✓
29	328	✓	✓	✓	✓	✓	682	✓	✓	—	5PB
30	681	✓	✓	✓	✓	EVV	✓	✓	✓	IDL	✓
31	18J	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
32	KYJ	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
33	290	✓	✓	✓	✓	64P	✓	✓	✓	—	✓
34	FFA	✓	✓	✓	✓	✓	✓	✓	✓	—	✓
35	9VK	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
36	8PV	✓	✓	✓	✓	487	—	✓	✓	✓	✓

3

LICENSE PLATE CHECK FIELD DATA SHEET

City ________ Date ________ Recorded by ________ Side of Street ________

Street ________ between ________ and ________

Codes: 000 last three digits of license number; √ for repeat number from prior circuit; _ for empty space

Space and Regulation	Time circuit begins										
	11–	11:20	11:40	12:[illegible]	12:20	12:40	1:00	1:20	1:40	2:00	2:20
37	R2D	✓	✓	✓	✓	✓	✓	✓	✓	TV6	✓
38	ZLM	TCD	✓	HBE	✓	HMR	RYN	✓	✓	✓	✓
39	VBY	✓	✓	✓	✓	—	—	✓	LJN	✓	—
40	KMK	✓	✓	✓	✓	✓	—	✓	✓	✓	—
41	C	KW	EDG	✓	✓	BXE	—	✓	✓	739	—
42 ✓	144	✓	✓	✓	✓	MAP	[illegible]	✓	47	✓	✓
43	C	✓	✓	✓	✓	✓	✓	✓	RTA	—	✓
44	CONSTRUCTION					✓	✓	✓	77R	✓	930
45	C	✓	✓	✓	✓	✓	✓	✓	924	✓	—
46	C	✓	✓	✓	✓	✓	✓	✓	MAS	LCL	—
47	CXX	✓	✓	✓	✓	—	AFL	✓	✓	✓	—
48	334	✓	✓	✓	✓	✓	✓	✓	✓	✓	—
49	922	✓	✓	✓	✓	—	✓	✓	✓	✓	—
50	42W	✓	✓	✓	✓	✓	✓	✓	✓	✓	—
51	712	✓	✓	✓	—	✓	✓	✓	✓	266	✓
52	145	✓	✓	✓	✓	✓	✓	✓	KCA	✓	—
53	~~CAB~~	FSI	✓	✓	—	SQJ	✓	✓	✓	DVS	✓
54	NKS	710	✓	✓	✓	✓	QVY	✓	✓	✓	✓

4

LICENSE PLATE CHECK FIELD DATA SHEET

City ______________ Date ______________ Recorded by ______________ Side of Street ______________

Street ______________ between ______________ and ______________

Codes: 000 last three digits of license number; √ for repeat number from prior circuit; _ for empty space

Space and Regulation	Time circuit begins											
	11 —	11:20	11:40	12:00	12:20	12:40	1:00	1:20	1:40	2:00	2:20	
55	OPP	✓	✓	✓	✓	✓	✓	✓	✓	—	—	
56	86Y	✓	✓	✓	✓	✓	✓	✓	365	—	—	
57	858	✓	✓	✓	✓	✓	✓	✓	✓	—	—	
58	5MP	✓	✓	✓	✓	✓	✓	✓	✓	EZD	—	
59	1EWW	✓	PSB	✓	✓	✓	✓	✓	✓	AHL	✓	
60	JBE	✓	✓	✓	✓	✓	✓	✓	✓	VTM	—	
61	C	ON	ST	RU	CT	ION	✓	✓	✓	—	✓	
62	C	ON	STRU	C	TIO	N	✓	✓	✓	—	✓	
62	081	✓	✓	✓	✓	✓	✓	✓	✓	—	✓	
63	775	✓	✓	✓	✓	✓	✓	✓	✓	—	✓	
64	32D	✓	✓	✓	✓	✓	✓	✓	✓	—	✓	
65	URM	✓	MBC	✓	✓	✓	✓	✓	PNG	—	✓	
66 HP	617	✓	✓	✓	✓	✓	✓	✓	✓	—	✓	
67 HP	VCT	✓	✓	✓	✓	✓	✓	✓	✓	—	✓	
68 HP	TLL	✓	✓	✓	✓	✓	✓	✓	✓	—	✓	
69 HP	00H	✓	✓	✓	✓	✓	✓	✓	✓	—	✓	
70	372	ETH	✓	✓	✓	✓	✓	✓	✓	—	✓	
71	KFH	✓	✓	✓		✓	✓	✓	✓	—	✓	

LICENSE PLATE CHECK FIELD DATA SHEET

5

City ______ Date ______ Recorded by ______ Side of Street ______

Street ______ between ______ and ______

Codes: 000 last three digits of license number; ✓ for repeat number from prior circuit; __ for empty space

Space and Regulation	Time circuit begins											
	11-	11:20	11:40	12:00	12:20	12:40	1:00	1:20	1:40	2:00	2:20	
72	MDP	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
73	823	✓	✓	✓	✓	JBL	✓	✓	✓	55R	✓	
74	VAM	✓	✓	✓	✓	✓	✓	✓	✓	✓	X0T	
75	517	52A	LPA	✓	✓	✓	✓	✓	✓	✓	B66	

Appendix B4

Patient and Auditorium Users Transportation Survey

OUTPATIENT SURVEY SUMMARY

TOTAL RESPONSES	222	
	NUMBER	%
CARS	150	67.57%
MBTA	32	14.41%
BUS	12	5.41%
TAXI	7	3.15%
SHRINER VAN	8	3.60%
OTHER	13	5.86%
PARKING		
HAWTHORNE	14	9.33%
MGH GARAGE	38	25.33%
OTHER GARAGES	37	24.67%
METER	61	40.67%

INPATIENT PARKING DEMAND

TOTAL RESPONSES	38	
	NUMBER	%
CARS	24	63.16%
MBTA	4	10.53%
BUS	1	2.63%
TAXI	4	10.53%
SHRINER VAN	2	5.26%
OTHER	3	7.89%
PARKING		
HAWTHORNE	1	4.17%
MGH GARAGE	1	4.17%
OTHER GARAGES	6	25.00%
METER	16	66.67%

```
. IF      HOME    HOTEL    SCHOOL HOSPITALAIRPORT
     AUDITORIUM USERS PARKING DEMAND

     TOTAL RESPONSES        114
                         NUMBER      %
     CARS                    73    64.04%
     MBTA                    15    13.16%
     TAXI                     0     0.00%
     WALK                    20    17.54%
     OTHER                    6     5.26%


     PARKING
     HAWTHORNE                0     0.00%
     MGH GARAGE              24    32.88%
     OTHER GARAGES           13    17.81%
     METER                   27    36.99%
     OTHER                    9    12.33%
```

Appendix B5

Trip Generation

```
SHRINERS - EXISTING TRIP GENERATION BASED ON ITE VALUES

SUMMARY OF TRIP GENERATION CALCULATION

FOR  270  EMPLOYEES OF HOSPITAL

9/30/91
_________________________________________________________________________
                                                                  DRIVE
                         AVERAGE   STANDARD   ADJUSTMENT          WAY
                          RATE     DEVIATION    FACTOR           VOLUME
_________________________________________________________________________

AVG WKDY 2-WAY VOL        6.63       0.00        1.00             1791
7-9 AM PK HR ENTER        0.13       0.00        1.00               36
7-9 AM PK HR EXIT         0.05       0.00        1.00               15
7-9 AM PK HR TOTAL        0.19       0.00        1.00               51
4-6 PM PK HR ENTER        0.03       0.00        1.00                7
4-6 PM PK HR EXIT         0.06       0.00        1.00               16
4-6 PM PK HR TOTAL        0.08       0.00        1.00               23
AM GEN PK HR ENTER        0.22       0.00        1.00               60
AM GEN PK HR EXIT         0.10       0.00        1.00               27
AM GEN PK HR TOTAL        0.32       0.00        1.00               86
PM GEN PK HR ENTER        0.23       0.00        1.00               63
PM GEN PK HR EXIT         0.45       0.00        1.00              122
PM GEN PK HR TOTAL        0.68       0.00        1.00              184
SATURDAY 2-WAY VOL        0.00       0.00        1.00                0
PK HR ENTER               0.00       0.00        1.00                0
PK HR EXIT                0.00       0.00        1.00                0
PK HR TOTAL               0.00       0.00        1.00                0
SUNDAY 2-WAY VOL          4.80       0.00        1.00             1296
PK HR ENTER               0.27       0.00        1.00               72
PK HR EXIT                0.42       0.00        1.00              113
PK HR TOTAL               0.69       0.00        1.00              185
_________________________________________________________________________

Note: A zero rate indicates no rate data available
      The above rates were calculated from these equations:

24-Hr. 2-Way Volume:     LN(T) =  .771LN(X) +  3.174, R^2 =  .75
7-9 AM Peak Hr. Total:   T =  .365(X) + -47.787
                         R^2 =  .9 ,  .71  Enter,  .29  Exit
4-6 PM Peak Hr. Total:   T =  .34(X) + -68.947
                         R^2 =  .97 ,  .3  Enter,  .7  Exit
AM Gen Pk Hr. Total:     T =  .356(X) + -9.646
                         R^2 =  .94 ,  .69  Enter,  .31  Exit
PM Gen Pk Hr. Total:     T =  .362(X) +  86.474
                         R^2 =  .78 ,  .34  Enter,  .66  Exit
Sat. 2-Way Volume:       0, R^2 =  0
Sat. Pk Hr. Total:       0
                         R^2 =  0 ,  0  Enter,  0  Exit
Sun. 2-Way Volume:       T =  2.574(X) +  600.656, R^2 =  .86
Sun. Pk Hr. Total:       T =  .374(X) +  84.23
                         R^2 =  .48 ,  .39  Enter,  .61  Exit

Source: Institute of Transportation Engineers
        Trip Generation, 5th Edition, 1991.
```

SHRINERS - PROPOSED TRIP GENERATION BASED ON ITE VALUES

SUMMARY OF TRIP GENERATION CALCULATION

FOR 332 EMPLOYEES OF HOSPITAL

9/30/91

	AVERAGE RATE	STANDARD DEVIATION	ADJUSTMENT FACTOR	DRIVE WAY VOLUME
AVG WKDY 2-WAY VOL	6.33	0.00	1.00	2100
7-9 AM PK HR ENTER	0.16	0.00	1.00	52
7-9 AM PK HR EXIT	0.06	0.00	1.00	21
7-9 AM PK HR TOTAL	0.22	0.00	1.00	73
4-6 PM PK HR ENTER	0.04	0.00	1.00	13
4-6 PM PK HR EXIT	0.09	0.00	1.00	31
4-6 PM PK HR TOTAL	0.13	0.00	1.00	44
AM GEN PK HR ENTER	0.23	0.00	1.00	75
AM GEN PK HR EXIT	0.10	0.00	1.00	34
AM GEN PK HR TOTAL	0.33	0.00	1.00	109
PM GEN PK HR ENTER	0.21	0.00	1.00	70
PM GEN PK HR EXIT	0.41	0.00	1.00	136
PM GEN PK HR TOTAL	0.62	0.00	1.00	207
SATURDAY 2-WAY VOL	0.00	0.00	1.00	0
PK HR ENTER	0.00	0.00	1.00	0
PK HR EXIT	0.00	0.00	1.00	0
PK HR TOTAL	0.00	0.00	1.00	0
SUNDAY 2-WAY VOL	4.38	0.00	1.00	1455
PK HR ENTER	0.24	0.00	1.00	81
PK HR EXIT	0.38	0.00	1.00	127
PK HR TOTAL	0.63	0.00	1.00	2[illegible]

Note: A zero rate indicates no rate data available
The above rates were calculated from these equations:

24-Hr. 2-Way Volume: LN(T) = .771LN(X) + 3.174, Rˆ2 = .75
7-9 AM Peak Hr. Total: T = .365(X) + -47.787
Rˆ2 = .9 , .71 Enter, .29 Exit
4-6 PM Peak Hr. Total: T = .34(X) + -68.947
Rˆ2 = .97 , .3 Enter, .7 Exit
AM Gen Pk Hr. Total: T = .356(X) + -9.646
Rˆ2 = .94 , .69 Enter, .31 Exit
PM Gen Pk Hr. Total: T = .362(X) + 86.474
Rˆ2 = .78 , .34 Enter, .66 Exit
Sat. 2-Way Volume: 0, Rˆ2 = 0
Sat. Pk Hr. Total: 0
Rˆ2 = 0 , 0 Enter, 0 Exit
Sun. 2-Way Volume: T = 2.574(X) + 600.656, Rˆ2 = .86
Sun. Pk Hr. Total: T = .374(X) + 84.23
Rˆ2 = .48 , .39 Enter, .61 Exit

Source: Institute of Transportation Engineers

EMPLOYEE SURVEY RESULTS

AM PEAK HOUR - 7-8 AM

EMPLOYEE PERSON-TRIPS ENTERING	79
ENTERING TRIP RATE	0.4072
EMPLOYEE PERSON-TRIPS EXITING	1
EXITING TRIP RATE	0.0052

PEAK HOUR MODAL SPLIT	NUMBER	PCT
CARS	39	48.8%
TRANSIT	36	45.0%
WALK	4	5.0%
BICYCLE	1	0.2%
OTHER	0	0.0%

PASSENGERS/CAR 1.2564

PM PEAK HOUR - 3-4 PM

EMPLOYEE PERSON-TRIPS ENTERING	3
ENTERING TRIP RATE	0.0155
EMPLOYEE PERSON-TRIPS EXITING	57
EXITING TRIP RATE	0.2938

PEAK HOUR MODAL SPLIT	NUMBER	PCT
CARS	32	53.3%
TRANSIT	27	45.0%
WALK	1	1.7%
BICYCLE	0	0.0%
OTHER	0	0.0%

PASSENGERS/CAR 1.2813

TOTAL NUMBER OF RESPONDENTS - 194

Appendix B4

Patient and Auditorium Users Transportation Survey

OUTPATIENT SURVEY SUMMARY

TOTAL RESPONSES 222

	NUMBER	%
CARS	150	67.57%
MBTA	32	14.41%
BUS	12	5.41%
TAXI	7	3.15%
SHRINER VAN	8	3.60%
OTHER	13	5.86%
PARKING		
HAWTHORNE	14	9.33%
MGH GARAGE	38	25.33%
OTHER GARAGES	37	24.67%
METER	61	40.67%

INPATIENT PARKING DEMAND

TOTAL RESPONSES 38

	NUMBER	%
CARS	24	63.16%
MBTA	4	10.53%
BUS	1	2.63%
TAXI	4	10.53%
SHRINER VAN	2	5.26%
OTHER	3	7.89%
PARKING		
HAWTHORNE	1	4.17%
MGH GARAGE	1	4.17%
OTHER GARAGES	6	25.00%
METER	16	66.67%

```
ZIP       HOME    HOTEL    SCHOOL HOSPITALAIRPORT
      AUDITORIUM USERS PARKING DEMAND

      TOTAL RESPONSES       114
                          NUMBER     %
      CARS                    73    64.04%
      MBTA                    15    13.16%
      TAXI                     0     0.00%
      WALK                    20    17.54%
      OTHER                    6     5.26%


      PARKING
      HAWTHORNE                0     0.00%
      MGH GARAGE              24    32.88%
      OTHER GARAGES           13    17.81%
      METER                   27    36.99%
      OTHER                    9    12.33%
```

Appendix B5

Trip Generation

```
SHRINERS - EXISTING TRIP GENERATION BASED ON ITE VALUES

SUMMARY OF TRIP GENERATION CALCULATION

FOR  270  EMPLOYEES OF HOSPITAL

9/30/91
________________________________________________________________________
                                                                  DRIVE
                          AVERAGE    STANDARD    ADJUSTMENT        WAY
                           RATE      DEVIATION     FACTOR        VOLUME
________________________________________________________________________

AVG WKDY 2-WAY VOL         6.63        0.00         1.00          1791
7-9 AM PK HR ENTER         0.13        0.00         1.00            36
7-9 AM PK HR EXIT          0.05        0.00         1.00            15
7-9 AM PK HR TOTAL         0.19        0.00         1.00            51
4-6 PM PK HR ENTER         0.03        0.00         1.00             7
4-6 PM PK HR EXIT          0.06        0.00         1.00            16
4-6 PM PK HR TOTAL         0.08        0.00         1.00            23
AM GEN PK HR ENTER         0.22        0.00         1.00            60
AM GEN PK HR EXIT          0.10        0.00         1.00            27
AM GEN PK HR TOTAL         0.32        0.00         1.00            86
PM GEN PK HR ENTER         0.23        0.00         1.00            63
PM GEN PK HR EXIT          0.45        0.00         1.00           122
PM GEN PK HR TOTAL         0.68        0.00         1.00           184
SATURDAY 2-WAY VOL         0.00        0.00         1.00             0
PK HR ENTER                0.00        0.00         1.00             0
PK HR EXIT                 0.00        0.00         1.00             0
PK HR TOTAL                0.00        0.00         1.00             0
SUNDAY 2-WAY VOL           4.80        0.00         1.00          1296
PK HR ENTER                0.27        0.00         1.00            72
PK HR EXIT                 0.42        0.00         1.00           113
PK HR TOTAL                0.69        0.00         1.00           185
________________________________________________________________________

Note: A zero rate indicates no rate data available
      The above rates were calculated from these equations:

24-Hr. 2-Way Volume:       LN(T) =  .771LN(X) +  3.174, R^2 =  .75
7-9 AM Peak Hr. Total:     T =  .365(X) + -47.787
                           R^2 =  .9 ,  .71  Enter,  .29  Exit
4-6 PM Peak Hr. Total:     T =  .34(X) + -68.947
                           R^2 =  .97 ,  .3  Enter,  .7  Exit
AM Gen Pk Hr. Total:       T =  .356(X) + -9.646
                           R^2 =  .94 ,  .69  Enter,  .31  Exit
PM Gen Pk Hr. Total:       T =  .362(X) +  86.474
                           R^2 =  .78 ,  .34  Enter,  .66  Exit
Sat. 2-Way Volume:         0, R^2 =  0
Sat. Pk Hr. Total:         0
                           R^2 =  0 ,  0  Enter,  0  Exit
Sun. 2-Way Volume:         T =  2.574(X) +  600.656, R^2 =  .86
Sun. Pk Hr. Total:         T =  .374(X) +  84.23
                           R^2 =  .48 ,  .39  Enter,  .61  Exit

Source: Institute of Transportation Engineers
        Trip Generation, 5th Edition, 1991.
```

SHRINERS - PROPOSED TRIP GENERATION BASED ON ITE VALUES

SUMMARY OF TRIP GENERATION CALCULATION

FOR 332 EMPLOYEES OF HOSPITAL

9/30/91

	AVERAGE RATE	STANDARD DEVIATION	ADJUSTMENT FACTOR	DRIV WAY VOLUM
AVG WKDY 2-WAY VOL	6.33	0.00	1.00	2100
7-9 AM PK HR ENTER	0.16	0.00	1.00	52
7-9 AM PK HR EXIT	0.06	0.00	1.00	21
7-9 AM PK HR TOTAL	0.22	0.00	1.00	73
4-6 PM PK HR ENTER	0.04	0.00	1.00	13
4-6 PM PK HR EXIT	0.09	0.00	1.00	31
4-6 PM PK HR TOTAL	0.13	0.00	1.00	44
AM GEN PK HR ENTER	0.23	0.00	1.00	75
AM GEN PK HR EXIT	0.10	0.00	1.00	34
AM GEN PK HR TOTAL	0.33	0.00	1.00	109
PM GEN PK HR ENTER	0.21	0.00	1.00	70
PM GEN PK HR EXIT	0.41	0.00	1.00	136
PM GEN PK HR TOTAL	0.62	0.00	1.00	207
SATURDAY 2-WAY VOL	0.00	0.00	1.00	0
PK HR ENTER	0.00	0.00	1.00	0
PK HR EXIT	0.00	0.00	1.00	0
PK HR TOTAL	0.00	0.00	1.00	0
SUNDAY 2-WAY VOL	4.38	0.00	1.00	1455
PK HR ENTER	0.24	0.00	1.00	81
PK HR EXIT	0.38	0.00	1.00	127
PK HR TOTAL	0.63	0.00	1.00	208

Note: A zero rate indicates no rate data available
The above rates were calculated from these equations:

```
24-Hr. 2-Way Volume:      LN(T) =  .771LN(X) +  3.174, R^2 =  .75
7-9 AM Peak Hr. Total:    T =  .365(X) + -47.787
                          R^2 =  .9 ,  .71  Enter,  .29  Exit
4-6 PM Peak Hr. Total:    T =  .34(X) + -68.947
                          R^2 =  .97 ,  .3  Enter,  .7  Exit
AM Gen Pk Hr. Total:      T =  .356(X) + -9.646
                          R^2 =  .94 ,  .69  Enter,  .31  Exit
PM Gen Pk Hr. Total:      T =  .362(X) +  86.474
                          R^2 =  .78 ,  .34  Enter,  .66  Exit
Sat. 2-Way Volume:        0, R^2 =  0
Sat. Pk Hr. Total:        0
                          R^2 =  0 ,  0  Enter,  0  Exit
Sun. 2-Way Volume:        T =  2.574(X) +  600.656, R^2 =  .86
Sun. Pk Hr. Total:        T =  .374(X) +  84.23
                          R^2 =  .48 ,  .39  Enter,  .61  Exit
```

Source: Institute of Transportation Engineers

EMPLOYEE SURVEY RESULTS

AM PEAK HOUR - 7-8 AM

EMPLOYEE PERSON-TRIPS ENTERING	79
ENTERING TRIP RATE	0.4072
EMPLOYEE PERSON-TRIPS EXITING	1
EXITING TRIP RATE	0.0052

PEAK HOUR MODAL SPLIT	NUMBER	PCT
CARS	39	48.8%
TRANSIT	36	45.0%
WALK	4	5.0%
BICYCLE	1	0.2%
OTHER	0	0.0%

PASSENGERS/CAR	1.2564

PM PEAK HOUR - 3-4 PM

EMPLOYEE PERSON-TRIPS ENTERING	3
ENTERING TRIP RATE	0.0155
EMPLOYEE PERSON-TRIPS EXITING	57
EXITING TRIP RATE	0.2938

PEAK HOUR MODAL SPLIT	NUMBER	PCT
CARS	32	53.3%
TRANSIT	27	45.0%
WALK	1	1.7%
BICYCLE	0	0.0%
OTHER	0	0.0%

PASSENGERS/CAR	1.2813

TOTAL NUMBER OF RESPONDENTS - 194

Appendix C

Air Quality

APPENDIX C
AIR QUALITY MODELING METHODOLOGIES

C.1 Motor Vehicle Emissions

Motor vehicle emissions used in this analysis were generated by the EPA MOBILE4 computer program.[1] Modeling inputs were based on Department of Environmental Protection (DEP)[2] and Boston Redevelopment Authority (BRA)[3] approved protocol procedures. The air modeling protocol is included as Section C.4 of this appendix, and provides MOBILE4 modeling parameters. MOBILE4 output is provided in Section C.5 of this appendix.

Idle mode emission rates for the CAL3QHC queuing emission requirements are calculated using recommended EPA procedures.[4] Adjustment is necessary since idle mode emissions generated by MOBILE4 are based only on hot stabilized conditions. MOBILE4 idle mode emission rates were multiplied by the composite emission rate at 2.5 mph for 30°F and the appropriate cold/hot start ratio divided by the composite emission rate for testing conditions (2.5 mph, 70°F, RVP of 9.0, hot stabilized conditions). Calculations of idle mode emission rates are provided after MOBILE4 output.

C.2 CAL3QHC Model

The EPA CAL3QHC[5] computer program was used to predict CO concentrations at sensitive receptor locations. The CAL3QHC program utilizes the FHWA CALINE3[6] computer model combined with a queuing routine to predict impacts from intersections. The CAL3QHC intersection analysis involves the development of queue links at intersections and the subsequent modeling of these with idling emissions. Modeling assumptions are outlined in the modeling protocol, Section C.4 of this document.

Peak one-hour turning movement traffic data from the Transportation Access Plan Component of the DPIR/DEIR is input to the CAL3QHC model for each case. To determine the average eight-hour CO concentrations, an estimate of the average hour of the peak eight-hour traffic period is used. The average hour traffic data is assumed to be a factor of the peak one-hour traffic data. This factor is determined by a ratio of the average hour in the peak eight hours to the peak hour in the peak eight hours, as recorded by automatic traffic recorders in the project area. A factor of 0.78 was used in this analysis.

CAL3QHC modeling results are provided as Section C.6 of this appendix.

C.3 Proposed Parking Garage Analysis

A separate analysis was performed to determine impacts of the project's proposed underground parking garage. The parking facility analysis predicted maximum one-hour and eight-hour CO concentrations, for the Build configuration, using the EPA MOBILE4 computer program, EPA Indirect Source Guidelines and Halitsky's gas diffusion equations.[7] Concentrations were calculated at all receptor locations, in conjunction with a worst case wind speeds of 1 m/s.

Peak PM hour traffic is from the Transportation Access Plan Component. Garage peak and eight-hour traffic data was determined by the transportation engineers for this analysis. Garage peak occurs about 1 to 2 PM. Traffic volumes are included in the calculations in Section C.7 of this appendix.

Presently, design of the parking garage and its ventilation system have not been finalized, however, exhaust locations and ventilation system design specifications currently under consideration were modeled. Plans are that the proposed underground garage will be serviced by a forced air ventilation unit with two exhaust vents. Exhaust vents will be located on the Blossom Street side of the facility. The exhaust vents will have a total exit area of approximately 30 feet by 6 feet with a flow rate totaling about 92,000 cfm.

Emissions were estimated using the methodology for Worksheet 3 of the EPA Indirect Source Guidelines.[8] Calculations are included in Section C.7 of this appendix. The ventilation system will emit a total of 0.072 g/s of CO during the peak one-hour period, 0.088 g/s of CO during the eight-hour period, and 0.154 g/s of CO during the peak garage hour.

The concentration of CO in the ventilation system exhaust was determined by the following formula:

$$X = 870\,(Q + (X_b)(F))/F$$

where:

X = CO concentration in the ventilation exhaust (ppm).

Q = CO concentration rate for the vent system (g/s).

X_b = Background concentration of CO in the makeup air assumed equal to the 1994 background concentrations used in this analysis (g/m^3).

F = Volumetric flow rate (m^3/s).

Background concentrations of 5.0 ppm and 3.0 ppm were used for the one-hour and eight-hour periods. These levels are equivalent to 5.75 (10^{-3}) and 3.45 (10^{-3}) g/m^3, respectively.

For near-field receptors such as those being considered, ambient concentrations were scaled from the ventilation air concentrations using Halitsky's empirical model for gas diffusion near buildings. This model states that the ambient concentration X_a equals:

$$X_a = X/D$$

where D is a dilution factor defined as follows:

$$D = 2.22\,M\,[3.16 + (0.1(S))/(A_e)^{1/2}]^2\,V/V_e$$

The terms are defined as follows:

M = Building configuration factor, equal to 4.0.

S = Shortest arc distance from source to receptor (m).

A_e = Area of an exhaust opening.

V = Ambient wind velocity.

V_e = Source exit velocity.

For each case, the impacts of traffic on the streets closest to the receptors were also included in the calculation of worst case CO concentrations. Traffic impacts for Blossom Street and Cardinal O'Connell Way were evaluated at the seven receptors using the CAL3QHC model. CAL3QHC results include background concentrations of 5 ppm for the one-hour case and 3 ppm for the eight-hour case and the garage peak hour case. The one-hour analysis and garage peak hour analysis traffic is in the PM-peak hour for the 1994 Build case as described in the Transportation Access Plan Component. Traffic data for the eight-hour analysis is the peak PM one-hour factored by 0.78.

Section C.7 provides garage analysis calculations including the model input parameters and results for each receptor examined for the one-hour and eight-hour periods. These input values represent actual physical characteristics of the ventilation system as presented above, source-receptor geometry, and worst case wind conditions.

C.4 Air Quality Modeling Protocol

hm HMM ASSOCIATES, INC.
ENGINEERS ENVIRONMENTAL CONSULTANTS & PLANNERS
A Summit Environmental Group Company

HMM Ref. No. 5582-201/IND-3926

September 5, 1991

Mr. Richard Mertens
Environmental Review Officer
Boston Redevelopment Authority
City Hall - 9th Floor
One City Hall Square
Boston, MA 02201

Mr. Jon Anderson
Division of Air Quality Control
DEP
One Winter Street - 7th Floor
Boston, MA 02108

Subject: Proposed Air Quality Modeling Protocol for
The Shriners Burns Institute Replacement Facility Project

Dear Dick and Jon:

This letter serves to propose a modeling protocol for the indirect source analysis for the Shriners Burns Institute Replacement Facility Project. The project proposes to replace an existing 80,000 SF, 6 story building with a 200,000 SF replacement facility with 9 stories above ground. The project is two-phased, and requires the existing facility to remain in operation until new hospital space is constructed above the existing structure. Following completion of the new hospital, the existing structure will be replaced by research space, and an auditorium and a parking garage on two levels below grade.

As per my telephone discussions of August 29 with both of you, only one intersection meets the BRA's criteria for an air quality study (i.e. LOS D with 10% project related growth or LOS E or F). This intersection is Cambridge/Staniford/Temple Streets. PM peak hour traffic volumes will be used in the study since this period corresponds to the worst LOS. A one to eight hour factor of .78 to determine eight hour traffic volumes has been provided by the project traffic engineer, H.W. Moore Associates, Inc. The analysis will be included in the Draft Project Impact Report/Draft Environmental Impact Report (DPIR/DEIR).

The analysis will address CO emissions and resulting concentrations at the intersection of Cambridge/Staniford/Temple and in the vicinity of the proposed underground parking garage. These sources will be evaluated for the base year (1991) and the 1994 Build and No-Build cases. The analysis will use the EPA MOBILE4 and CAL3QHC computer models to estimate CO emissions and concentrations at receptor locations. Maximum predicted one- and eight-hour CO concentrations will be compared with National Ambient Air Quality Standards (NAAQS).

196 Baker Avenue • Concord • Massachusetts • 01742 • (508) 371-4000 • FAX: (508) 371-2468
Three Executive Park Drive • Bedford • New Hampshire • [illegible] • [illegible] 647-7010 • FAX: (603) 626-4642

Availability of MOBILE4.1 model is being researched with EPA. MOBILE4 or MOBILE4.1 will be used to calculate CO emissions incorporating the following assumptions:

- Ambient temperature of 30°F.
- Base and In Use RVP of 13.5 psi.
- ASTM Class C.
- 50% Cold / 10% Hot Starts for the peak 1-hour period and 20.6% Cold / 27.3% Hot Starts for the peak 8-hour period (default).
- Default VMT Mix/Vehicle Age Distribution.
- No anti-tampering program.
- Stage II Program.
    - Start Year: 1991
    - Phase In Period: 3 Years
    - 95% system efficiency for all vehicle types.
- Inspection/maintenance program.
    - Start Year: 1983
    - Stringency Factor 12%
    - First Model Year: Analysis year minus 14
    - Last Model Year: Analysis Year
    - Waiver Rate: 1%
    - Compliance Rate: 85%
    - Annual Inspection
    - Test Type: Idle
    - Cut Points: 1.2% CO / 220 PPM HC
    - No Alternative Credits
    - Program Type: Decentralized
- Estimates of actual travel speeds to queue.

Carbon monoxide concentrations will be determined with the CAL3QHC dispersion model (9/90 version). The following meteorological data and assumptions will be used:

- P-G Stability Class D.
- 1.0 meter per second (m/s) wind speed for peak 1-hour period and peak 8-hour period.
- Wind direction modeled every 10 degrees.
- Mixing Height: Winter average height of 850 meters (based on Holzworth, EPA AP 101, January 1972).
- Deposition/Settling Velocity: 0.0 m/s

- Surface Roughness (Z_0): 321 cm (CBD)
- Averaging Time: 60 minutes
- Source Height: 0.333 meters
- Free flow source lengths at each approach will be assumed to extend approximately a quarter mile back.
- Mixing Zone for Free Flow Links: Width of traffic lanes plus 3 meters (10 feet) on each side (as defined in the CAL3QHC Users Guide, page 28).
- Background CO Levels: 5.0 ppm for the peak 1-hour period and 3.0 ppm for the peak 8-hour period (all cases).

Figure 1 shows the project area, the proposed receptor network for the parking garage and the relative location of the Cambridge/Staniford/Temple intersection which will be studied. Figure 2 shows the basic geometry and receptor locations for the intersection. The garage ventilation exhaust openings will be located on the west side of the proposed building, approximately 20 feet above street level. The analysis will be based on preliminary exhaust volume and flow rate for these two vent openings. Receptors were selected at representative locations near the intersection and parking garage where prolonged public exposure may occur.

Parking garage emissions will be based on predicted traffic levels in the 1994 build case. The EPA MOBILE4 computer program and EPA Volume 9 Guideline's Worksheet 3 will be used to calculate garage exhaust vent emission rates. Halitsky's gas diffusion equation will be used to predict CO concentrations from the garage at selected receptor locations.

If this protocol meets with your approval, we would appreciate confirmation as soon as possible.

Sincerely,

Douglas L. Sheadel

Douglas Sheadel
Air Pollution Meteorologist

DS/dh
Enclosures

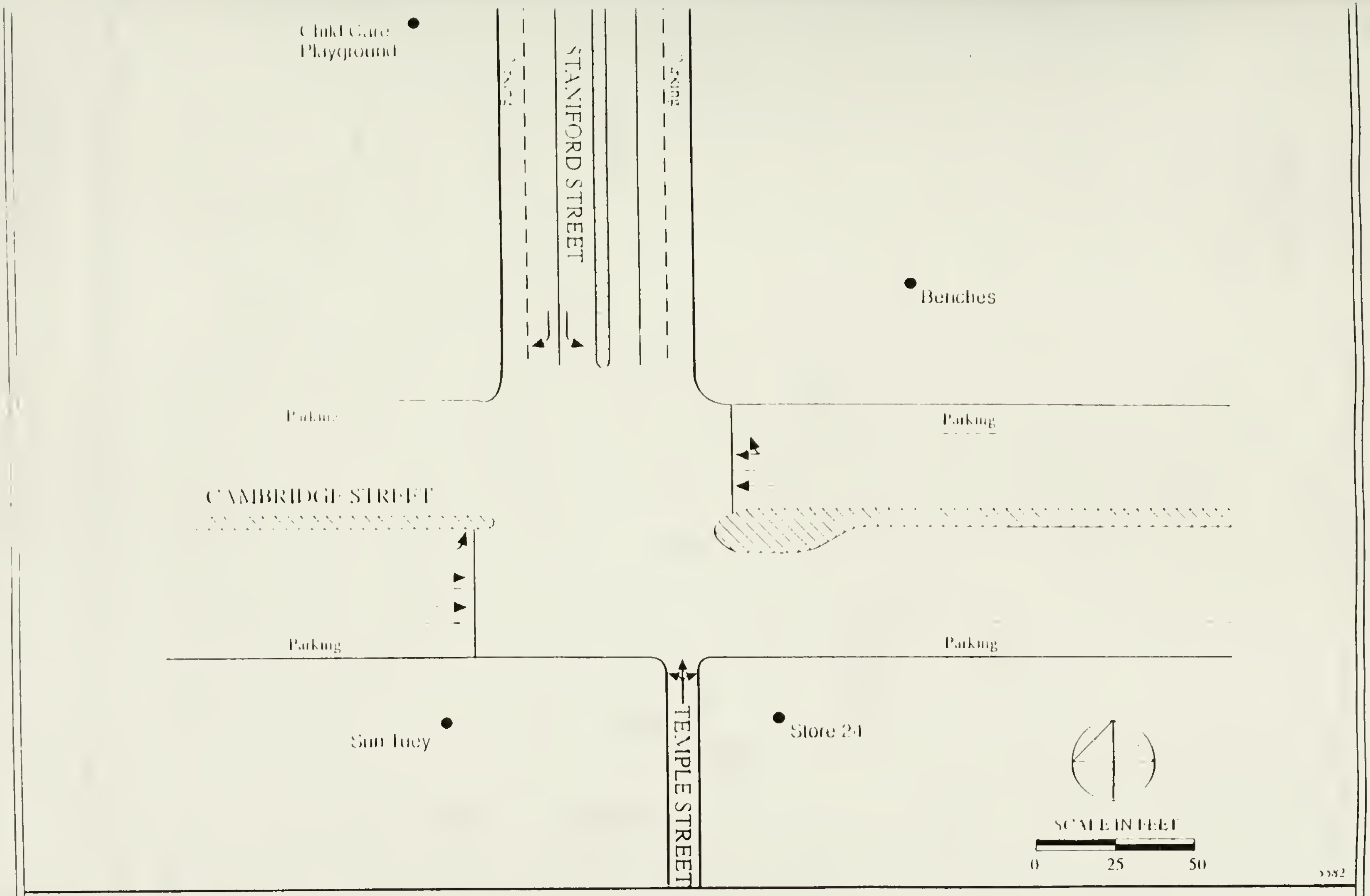

FIGURE 2
INTERSECTION GEOMETRY
CAMBRIDGE / STANIFORD / TEMPLE

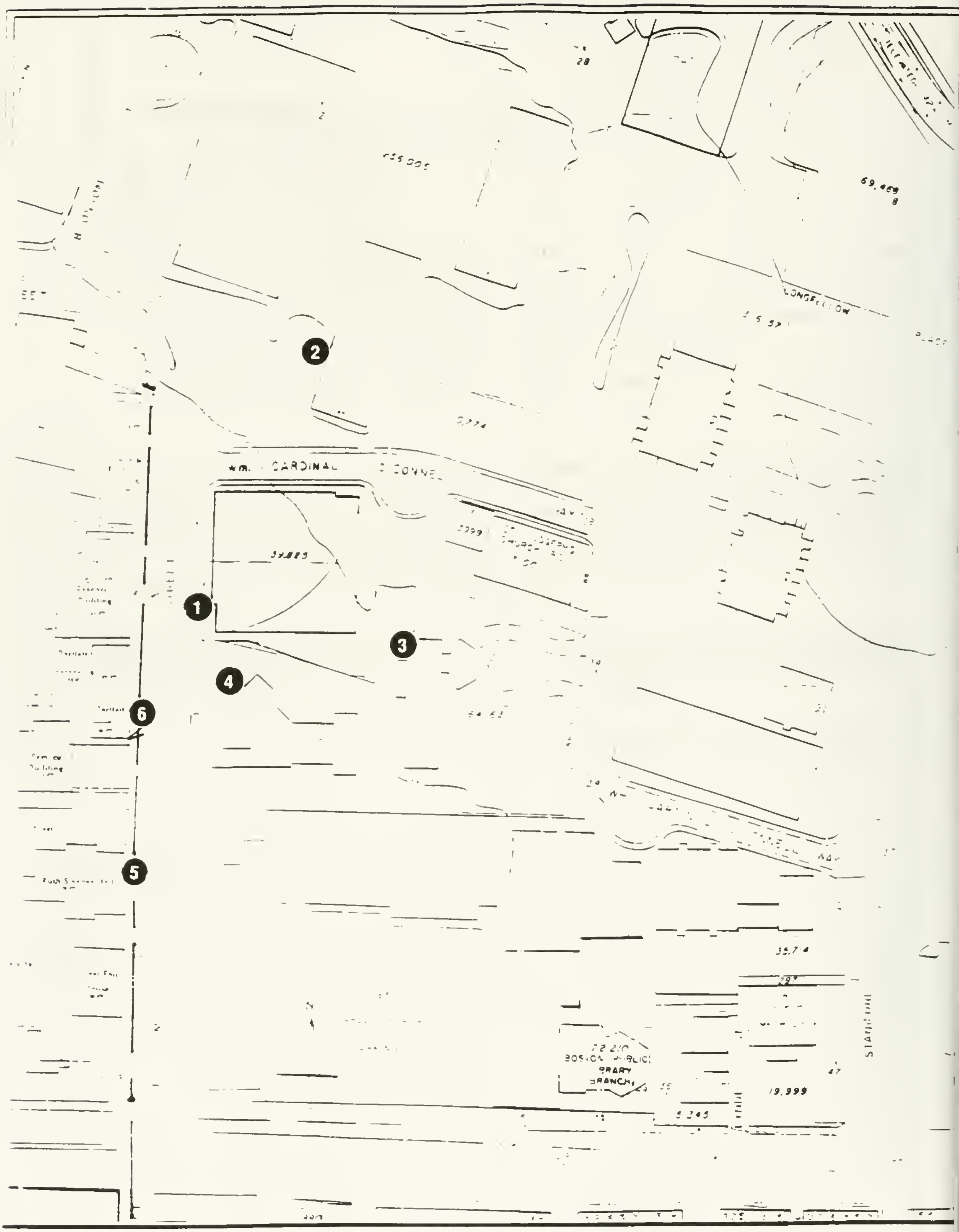

FIGURE 1
PROJECT AREA AND GARAGE MODELING RECEPTOR LOCATIONS

C.5 MOBILE4 Output

```
5582-201 SHRINERS HOSPITAL AIR QUALITY

I/M program selected:

    Start year (January 1):              1983
    Pre-1981 MYR stringency rate:         12%
    First model year covered:            1977
    Last model year covered:             1991
    Waiver rate (pre-1981):               1.%
    Waiver rate (1981 and newer):         1.%
    Compliance Rate:                     85.%
    Inspection type:                     Computerized decentralized
    Inspection frequency                 Annual
    Vehicle types covered:               LDGV - Yes
                                        LDGT1 - Yes
                                        LDGT2 - Yes
                                         HDGV - No
    1981 & later MYR test type:          Idle

Non-methane HC emission factors include evaporative HC emission factors.

--------------------------------------------------------------------------------

Cal. Year: 1991           Region: Low            Altitude:  500. Ft.
                    I/M Program: Yes        Ambient Temp:   75.0 / 75.0 / 75.0 F
              Anti-tam. Program: No       Operating Mode:     .0 /   .0 /   .0

1991 IDLE BASE        ASTM Class: C
                   Minimum Temp: 20. (F)   Maximum Temp: 80. (F)
                       Base RVP:  9.0   In-use (IU) RVP:  9.0   IU 1st Yr: 1989

Veh. Type:  LDGV  LDGT1  LDGT2   LDGT    HDGV   LDDV   LDDT   HDDV    MC   All Veh
Veh. Spd.:  2.5    2.5    2.5            2.5    2.5    2.5    2.5    2.5
  VMT Mix:  .709   .127   .086           .015   .014   .005   .033   .010

Composite Emission Factors (Gm/Mile)
No-Mth HC:  6.99   9.66  11.23  10.30  11.59   1.11   1.31   5.21   3.94   7.61
Exhst  CO: 82.73  93.43 107.31  99.04 187.62   3.73   3.89  38.29 122.37  85.20
Exhst NOX:  1.48   1.80   1.83   1.81   4.80   2.37   2.26  28.52    .80   2.51

Hot Stabilized Idle Emission Factors (Gm/Hr)
IM-Id  HC: 21.22  27.10  27.45  27.24  25.19   1.96   7.56  17.21  64.01  22.52
 Idle  CO:228.75 261.24 248.08 255.92 263.52  13.81  21.88  49.25 160.59 224.28
 Idle NOX:  3.41   3.72   3.56   3.65   3.17  11.97  15.56  21.03   2.40   4.22
--------------------------------------------------------------------------------

Cal. Year: 1991           Region: Low            Altitude:  500. Ft.
                    I/M Program: Yes        Ambient Temp:   30.0 / 30.0 / 30.0 F
              Anti-tam. Program: No       Operating Mode:   50.0 / 10.0 / 50.0

1991 IDLE 1-HR        ASTM Class: C
                   Minimum Temp: 20. (F)   Maximum Temp: 80. (F)
                       Base RVP: 13.5   In-use (IU) RVP: 13.5   IU 1st Yr: 1989

Veh. Type:  LDGV  LDGT1  LDGT2   LDGT    HDGV   LDDV   LDDT   HDDV    MC   All Veh
Veh. Spd.:  2.5    2.5    2.5            2.5    2.5    2.5    2.5    2.5
  VMT Mix:  .709   .127   .086           .015   .014   .005   .033   .010

Composite Emission Factors (Gm/Mile)
No-Mth HC: 35.59  43.35  47.69  45.10  16.21   1.38   1.67   5.21  24.73  35.53
Exhst  CO:347.65 375.97 409.02 389.32 229.55   5.68   5.88  38.29 362.53 337.95
Exhst NOX:  2.72   3.29   3.38   3.33   5.28   2.41   2.58  28.52   1.06   3.72

Hot Stabilized Idle Emission Factors (Gm/Hr)
IM-Id  HC: 21.22  27.10  27.45  27.24  25.19   1.96   7.56  17.21  64.01  22.52
 Idle  CO:228.75 261.24 248.08 255.92 263.52  13.81  21.88  49.25 160.59 224.28
Idle NOX:  3.41   3.72   3.56   3.65   3.17  11.97  15.56  21.03   2.40   4.22
--------------------------------------------------------------------------------

Cal. Year: 1991           Region: Low          Altitude:  500. Ft.
                    I/M Program: Yes       Ambient Temp:   30.0 / 30.0 / 30.0 F
              Anti-tam. Program: No      Operating Mode:   20.6 / 27.3 / 20.6

1991 IDLE 8-HR        ASTM Class: C
                  Minimum Temp: 20. (F)   Maximum Temo: 80. (F)
                      Base RVP: 13.5   In-use (IU) RVP: 13.5   IU 1st Yr: 1989

Veh. Type:  LDGV   LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV    MC   All Veh
Veh. Spd.:  2.5    2.5    2.5           2.5    2.5    2.5    2.5    2.5
  VMT Mix:   .709   .127   .086          .015   .014   .005   .033   .010

Composite Emission Factors (Gm/Mile)
Non-Mth HC: 20.12  25.92  28.57  26.99  16.21   1.24   1.46   5.21  15.75  20.62
Exhst  CO:209.60 237.87 261.67 247.49 229.55   4.88   5.15  38.29 234.72 208.56
Exhst NOX:  2.55   3.08   3.17   3.12   5.28   2.37   2.47  28.52   1.18   3.56

Hot Stabilized Idle Emission Factors (Gm/Hr)
VM-Id HC: 21.22  27.10  27.45  27.24  25.19   1.96   7.56  17.21  64.01  22.52
 Idle  CO:228.75 261.24 248.08 255.92 263.52  13.81  21.88  49.25 160.59 224.28
 Idle NOX:  3.41   3.72   3.56   3.65   3.17  11.97  15.56  21.03   2.40   4.22
--------------------------------------------------------------------------------

Cal. Year: 1991           Region: Low          Altitude:  500. Ft.
                    I/M Program: Yes       Ambient Temp:   30.0 / 30.0 / 30.0 F
              Anti-tam. Program: No      Operating Mode:   50.0 / 10.0 / 50.0

1991 1-HOUR CAMB      ASTM Class: C
                  Minimum Temp: 20. (F)   Maximum Temp: 80. (F)
                      Base RVP: 13.5   In-use (IU) RVP: 13.5   IU 1st Yr: 1989

Veh. Type:  LDGV   LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV    MC   All Veh
Veh. Spd.: 10.0   10.0   10.0          10.0   10.0   10.0   10.0   10.0
  VMT Mix:   .709   .127   .086          .015   .014   .005   .033   .010

Composite Emission Factors (Gm/Mile)
Non-Mth HC:  9.09  11.28  12.25  11.67   8.48    .95   1.15   3.60   8.34   9.28
Exhst  CO: 96.97 107.44 113.59 109.93 122.03   3.20   3.31  21.55 100.33  95.82
Exhst NOX:  2.31   2.77   2.89   2.82   5.69   1.79   1.92  21.27    .86   3.08

Hot Stabilized Idle Emission Factors (Gm/Hr)
VM-Id  HC: 21.22  27.10  27.45  27.24  25.19   1.96   7.56  17.21  64.01  22.52
 Idle  CO:228.75 261.24 248.08 255.92 263.52  13.81  21.88  49.25 160.59 224.28
 Idle NOX:  3.41   3.72   3.56   3.65   3.17  11.97  15.56  21.03   2.40   4.22
--------------------------------------------------------------------------------

Cal. Year: 1991           Region: Low          Altitude:  500. Ft.
                    I/M Program: Yes       Ambient Temp:   30.0 / 30.0 / 30.0 F
              Anti-tam. Program: No      Operating Mode:   50.0 / 10.0 / 50.0

1991 1-HOUR CAMB      ASTM Class: C
                  Minimum Temp: 20. (F)   Maximum Temo: 80. (F)
                      Base RVP: 13.5   In-use (IU) RVP: 13.5   IU 1st Yr: 1989

Veh. Type:  LDGV   LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV    MC   All Veh
Veh. Spd.: 15.0   15.0   15.0          15.0   15.0   15.0   15.0   15.0
  VMT Mix:   .709   .127   .086          .015   .014   .005   .033   .010

Composite Emission Factors (Gm/Mile)
Non-Mth HC:  6.05   7.60   8.15   7.82   5.80    .76    .92   2.89   5.92   6.22
Exhst  CO: 68.71  77.35  79.40  78.18  85.78   2.31   2.39  15.55  65.17  67.89
Exhst NOX:  2.14   2.55   2.67   2.60   5.96   1.54   1.65  18.28    .83   2.81
```

```
Hot Stabilized Idle Emission Factors (Gm/Hr)
NM-Id  HC: 21.22  27.10  27.45  27.24  25.19   1.96   7.56  17.21  64.01  22.52
 Idle  CO:228.75 261.24 248.08 255.92 263.52  13.81  21.88  49.25 160.59 224.28
 Idle NOX:  3.41   3.72   3.56   3.65   3.17  11.97  15.56  21.03   2.40   4.22
________________________________________________________________________________

Cal. Year: 1991            Region: Low            Altitude:  500. Ft.
                      I/M Program: Yes       Ambient Temp:   30.0 / 30.0 / 30.0 F
                Anti-tam. Program: No      Operating Mode:   50.0 / 10.0 / 50.0

1991 1-HOUR STAN       ASTM Class: C
                     Minimum Temp: 20. (F)   Maximum Temp: 80. (F)
                         Base RVP: 13.5   In-use (IU) RVP: 13.5    IU 1st Yr: 1989

Veh. Type:  LDGV   LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV    MC   All Veh
Veh. Spd.: 20.0   20.0   20.0           20.0   20.0   20.0   20.0   20.0
  VMT Mix:   .709   .127   .086           .015   .014   .005   .033   .010

Composite Emission Factors (Gm/Mile)
Non-Mth HC:  4.53   5.76   6.13   5.91   4.14    .62    .76   2.37   4.81   4.68
Exhst  CO: 55.21  63.00  63.42  63.17  63.70   1.74   1.80  11.75  48.98  54.49
Exhst NOX:  2.03   2.41   2.51   2.45   6.24   1.37   1.47  16.29    .96   2.63

Hot Stabilized Idle Emission Factors (Gm/Hr)
NM-Id  HC: 21.22  27.10  27.45  27.24  25.19   1.96   7.56  17.21  64.01  22.52
 Idle  CO:228.75 261.24 248.08 255.92 263.52  13.81  21.88  49.25 160.59 224.28
 Idle NOX:  3.41   3.72   3.56   3.65   3.17  11.97  15.56  21.03   2.40   4.22
________________________________________________________________________________

Cal. Year: 1991            Region: Low            Altitude:  500. Ft.
                      I/M Program: Yes       Ambient Temp:   30.0 / 30.0 / 30.0 F
                Anti-tam. Program: No      Operating Mode:   50.0 / 10.0 / 50.0

1991 1-HOUR STAN       ASTM Class: C
                     Minimum Temp: 20. (F)   Maximum Temp: 80. (F)
                         Base RVP: 13.5   In-use (IU) RVP: 13.5    IU 1st Yr: 1989

Veh. Type:  LDGV   LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV    MC   All Veh
Veh. Spd.: 25.0   25.0   25.0           25.0   25.0   25.0   25.0   25.0
  VMT Mix:   .709   .127   .086           .015   .014   .005   .033   .010

Composite Emission Factors (Gm/Mile)
Non-Mth HC:  3.65   4.64   4.93   4.76   3.08    .52    .64   1.99   4.12   3.77
Exhst  CO: 44.43  50.86  50.70  50.80  49.99   1.38   1.43   9.28  39.05  43.81
Exhst NOX:  1.95   2.32   2.39   2.35   6.51   1.27   1.36  15.03   1.06   2.52

Hot Stabilized Idle Emission Factors (Gm/Hr)
NM-Id  HC: 21.22  27.10  27.45  27.24  25.19   1.96   7.56  17.21  64.01  22.52
 Idle  CO:228.75 261.24 248.08 255.92 263.52  13.81  21.88  49.25 160.59 224.28
 Idle NOX:  3.41   3.72   3.56   3.65   3.17  11.97  15.56  21.03   2.40   4.22
________________________________________________________________________________

Cal. Year: 1991            Region: Low            Altitude:  500. Ft.
                      I/M Program: Yes       Ambient Temp:   30.0 / 30.0 / 30.0 F
                Anti-tam. Program: No      Operating Mode:   20.6 / 27.3 / 20.6

 991 3-HOUR TEM        ASTM Class: C
                     Minimum Temp: 20. (F)   Maximum Temp: 80. (F)
                         Base RVP: 13.5   In-use (IU) RVP: 13.5    IU 1st Yr: 1989

Veh. Type:  LDGV   LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV    MC   All Veh
Veh. Spd.: 15.0   15.0   15.0           15.0   15.0   15.0   15.0   15.0
  VMT Mix:   .709   .127   .086           .015   .014   .005   .033   .010

Composite Emission Factors (Gm/Mile)
Non-Mth HC:  3.47   4.58   4.90   4.71   5.80    .68    .81   2.89   3.77   3.70
```

```
Exhst  CO: 40.90  48.65  50.56  49.42  35.78   1.98   2.09  15.55  42.19  41.82
Exhst NOX:  2.02   2.39   2.52   2.44   5.96   1.52   1.58  18.28    .98   2.69

Hot Stabilized Idle Emission Factors (Gm/Hr)
IM-Id  HC: 21.22  27.10  27.45  27.24  25.19   1.96   7.56  17.21  64.01  22.52
 Idle  CO:228.75 261.24 248.08 255.92 263.52  13.81  21.88  49.25 160.59 224.28
 Idle NOX:  3.41   3.72   3.56   3.65   3.17  11.97  15.56  21.03   2.40   4.22
_________________________________________________________________________________

Cal. Year: 1991            Region: Low           Altitude:  500. Ft.
                   I/M Program: Yes       Ambient Temp:   30.0 / 30.0 / 30.0 F
            Anti-tam. Program: No      Operating Mode:   20.6 / 27.3 / 20.6

1991 8HR ALL IN         ASTM Class: C
                Minimum Temp: 20. (F)   Maximum Temp: 80. (F)
                    Base RVP: 13.5   In-use (IU) RVP: 13.5   IU 1st Yr: 1989

Veh. Type:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV    MC   All Veh
Veh. Spd.: 20.0   20.0   20.0          20.0   20.0   20.0   20.0   20.0
  VMT Mix:   .709   .127   .086          .015   .014   .005   .033   .010

Composite Emission Factors (Gm/Mile)
No-Mth HC:  2.62   3.49   3.70   3.57   4.14    .56    .66   2.37   3.06   2.80
Exhst  CO: 32.40  39.08  39.83  39.38  63.70   1.50   1.58  11.75  31.71  33.07
Exhst NOX:  1.92   2.26   2.37   2.31   6.24   1.36   1.41  16.29   1.07   2.53

Hot Stabilized Idle Emission Factors (Gm/Hr)
IM-Id  HC: 21.22  27.10  27.45  27.24  25.19   1.96   7.56  17.21  64.01  22.52
 Idle  CO:228.75 261.24 248.08 255.92 263.52  13.81  21.88  49.25 160.59 224.28
 Idle NOX:  3.41   3.72   3.56   3.65   3.17  11.97  15.56  21.03   2.40   4.22
_________________________________________________________________________________

Cal. Year: 1991            Region: Low           Altitude:  500. Ft.
                   I/M Program: Yes       Ambient Temp:   30.0 / 30.0 / 30.0 F
            Anti-tam. Program: No      Operating Mode:   20.6 / 27.3 / 20.6

1991 8HR STAN           ASTM Class: C
                Minimum Temp: 20. (F)   Maximum Temp: 80. (F)
                    Base RVP: 13.5   In-use (IU) RVP: 13.5   IU 1st Yr: 1989

Veh. Type:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV    MC   All Veh
Veh. Spd.: 25.0   25.0   25.0          25.0   25.0   25.0   25.0   25.0
  VMT Mix:   .709   .127   .086          .015   .014   .005   .033   .010

Composite Emission Factors (Gm/Mile)
No-Mth HC:  2.11   2.81   2.98   2.88   3.08      7    .56   1.99   2.63   2.26
Exhst  CO: 26.08  31.56  31.83  31.67  49.99   1.18   1.25   9.28  25.29  26.59
Exhst NOX:  1.85   2.18   2.27   2.22   6.51   1.25   1.30  15.03   1.18   2.42

Hot Stabilized Idle Emission Factors (Gm/Hr)
IM-Id  HC: 21.22  27.10  27.45  27.24  25.19   1.96   7.56  17.21  64.01  22.52
 Idle  CO:228.75 261.24 248.08 255.92 263.52  13.81  21.88  49.25 160.59 224.28
 Idle NOX:  3.41   3.72   3.56   3.65   3.17  11.97  15.56  21.03   2.40   4.22
_________________________________________________________________________________
Stop - Program terminated.
```

```
5582-201 SHRINERS HOSPITAL AIR QUALITY

I/M program selected:

    Start year (January 1):              1983
    Pre-1981 MYR stringency rate:         12%
    First model year covered:            1980
    Last model year covered:             1994
    Waiver rate (pre-1981):               1.%
    Waiver rate (1981 and newer):         1.%
    Compliance Rate:                     85.%
    Inspection type:                     Computerized decentralized
    Inspection frequency                 Annual
    Vehicle types covered:               LDGV - Yes
                                        LDGT1 - Yes
                                        LDGT2 - Yes
                                         HDGV - No
    1981 & later MYR test type:          Idle

Non-methane HC emission factors include evaporative HC emission factors.

--------------------------------------------------------------------------------

Cal. Year: 1994          Region: Low         Altitude:  500. Ft.
                  I/M Program: Yes      Ambient Temp:   75.0 / 75.0 / 75.0 F
             Anti-tam. Program: No    Operating Mode:     .0 /   .0 /   .0

1994 IDLE BASE       ASTM Class: C
                   Minimum Temp: 20. (F)   Maximum Temp: 80. (F)
                       Base RVP:  9.0   In-use (IU) RVP:  9.0   IU 1st Yr: 1989

Veh. Type:  LDGV  LDGT1  LDGT2   LDGT    HDGV   LDDV   LDDT   HDDV    MC   All Veh
Veh. Spd.:  2.5    2.5    2.5            2.5    2.5    2.5    2.5    2.5
  VMT Mix:  .705   .123   .085           .015   .020   .009   .031   .010

Composite Emission Factors (Gm/Mile)
No-Mth HC:  5.60   8.24   9.14   8.61   9.65    .94   1.18   4.76   8.14   6.16
Exhst  CO: 55.68  64.70  76.21  69.41 138.93   3.50   3.70  36.22 122.23  58.35
Exhst NOX:  1.27   1.59   1.59   1.59   4.28   2.02   1.96  20.31    .80   1.99

Hot Stabilized Idle Emission Factors (Gm/Hr)
NM-Id  HC: 16.29  23.34  23.65  23.47  25.12   1.83   6.94  16.64  64.01  18.04
Idle   CO:159.27 196.75 196.62 196.70 247.95  12.68  21.32  48.64 160.59 160.76
Idle NOX:   2.65   2.82   2.76   2.79   2.81   9.84  11.91  16.63   2.40   3.34

--------------------------------------------------------------------------------

Cal. Year: 1994          Region: Low         Altitude:  500. Ft.
                  I/M Program: Yes      Ambient Temp:   30.0 / 30.0 / 30.0 F
             Anti-tam. Program: No    Operating Mode:   50.0 / 10.0 / 50.0

1994 IDLE 1-HR       ASTM Class: C
                   Minimum Temp: 20. (F)   Maximum Temp: 80. (F)
                       Base RVP: 13.5   In-use (IU) RVP: 13.5   IU 1st Yr: 1989

Veh. Type:  LDGV  LDGT1  LDGT2   LDGT    HDGV   LDDV   LDDT   HDDV    MC   All Veh
Veh. Spd.:  2.5    2.5    2.5            2.5    2.5    2.5    2.5    2.5
  VMT Mix:  .705   .123   .085           .015   .020   .009   .031   .010

Composite Emission Factors (Gm/Mile)
No-Mth HC: 32.11  37.87  39.62  38.59  14.00   1.17   1.51   4.76  22.54  31.33
Exhst  CO:259.70 272.51 237.81 278.76 173.15   5.25   5.57  36.22 362.11 248.94
Exhst NOX:  2.45   3.10   3.15   3.12   4.67   2.05   2.24  20.31   1.06   3.16

Hot Stabilized Idle Emission Factors (Gm/Hr)
NM-Id  HC: 16.29  23.34  23.65  23.47  25.12   1.83   6.94  16.64  64.01  18.04
Idle   CO:159.27 196.75 196.62 196.70 247.95  12.68  21.32  48.64 160.59 160.76
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.dle NOX:  2.65   2.82   2.76   2.79   2.81   9.84  11.91  16.63   2.40   3.34
```

```
Cal. Year: 1994           Region: Low          Altitude:  500. Ft.
                   I/M Program: Yes      Ambient Temp:   30.0 / 30.0 / 30.0 F
              Anti-tam. Program: No     Operating Mode:   20.6 / 27.3 / 20.6

1994 IDLE 8-HR        ASTM Class: C
                 Minimum Temp: 20. (F)   Maximum Temp: 80. (F)
                     Base RVP: 13.5   In-use (IU) RVP: 13.5   IU 1st Yr: 1989

.eh. Type:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV   MC   All Veh
.eh. Spd.:  2.5    2.5    2.5           2.5    2.5    2.5    2.5    2.5
 .MT Mix:   .705   .123   .085          .015   .020   .009   .031   .010

Composite Emission Factors (Gm/Mile)
No-Mth HC: 17.92  22.80  23.96  23.27  14.00   1.05   1.32   4.76  14.33  18.04
Exhst  CO:158.71 176.70 189.98 182.13 173.15   4.52   4.89  36.22 234.46 156.22
Exhst NOX:  2.27   2.82   2.86   2.84   4.67   2.02   2.15  20.31   1.18   2.97

Hot Stabilized Idle Emission Factors (Gm/Hr)
IM-Id  HC: 16.29  23.34  23.65  23.47  25.12   1.83   6.94  16.64  64.01  18.04
 Idle  CO:159.27 196.75 196.62 196.70 247.95  12.68  21.32  48.64 160.59 160.76
 Idle NOX:  2.65   2.82   2.76   2.79   2.81   9.84  11.91  16.63   2.40   3.34
```

```
Cal. Year: 1994           Region: Low          Altitude:  500. Ft.
                   I/M Program: Yes      Ambient Temp:   30.0 / 30.0 / 30.0 F
              Anti-tam. Program: No     Operating Mode:   50.0 / 10.0 / 50.0

1994 1-HOUR CAMB      ASTM Class: C
                 Minimum Temp: 20. (F)   Maximum Temp: 80. (F)
                     Base RVP: 13.5   In-use (IU) RVP: 13.5   IU 1st Yr: 1989

.eh. Type:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV   MC   All Veh
.eh. Spd.: 10.0   10.0   10.0          10.0   10.0   10.0   10.0   10.0
 .MT Mix:   .705   .123   .085          .015   .020   .009   .031   .010

Composite Emission Factors (Gm/Mile)
No-Mth HC:  8.04   9.60   9.94   9.77   7.33    .81   1.04   3.29   7.60   8.03
Exhst  CO: 76.86  83.86  86.50  84.94  92.04   2.96   3.14  20.39 100.22  75.08
Exhst NOX:  2.07   2.60   2.65   2.62   5.03   1.53   1.67  15.15    .86   2.61

Hot Stabilized Idle Emission Factors (Gm/Hr)
IM-Id  HC: 16.29  23.34  23.65  23.47  25.12   1.83   6.94  16.64  64.01  18.04
 Idle  CO:159.27 196.75 196.62 196.70 247.95  12.68  21.32  48.64 160.59 160.76
 Idle NOX:  2.65   2.82   2.76   2.79   2.81   9.84  11.91  16.63   2.40   3.34
```

```
Cal. Year: 1994           Region: Low          Altitude:  500. Ft.
                   I/M Program: Yes      Ambient Temp:   30.0 / 30.0 / 30.0 F
              Anti-tam. Program: No     Operating Mode:   50.0 / 10.0 / 50.0

1994 1-HOUR CAMB      ASTM Class: C
                 Minimum Temp: 20. (F)   Maximum Temp: 80. (F)
                     Base RVP: 13.5   In-use (IU) RVP: 13.5   IU 1st Yr: 1989

.eh. Type:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV   MC   All Veh
.eh. Spd.: 15.0   15.0   15.0          15.0   15.0   15.0   15.0   15.0
 .MT Mix:   .705   .123   .085          .015   .020   .009   .031   .010

Composite Emission Factors (Gm/Mile)
No-Mth HC:  5.33   6.47   6.58   6.51   5.01    .65    .83   2.64   5.40   5.35
Exhst  CO: 56.61  63.02  63.71  63.30  64.70   2.13   2.26  14.71  65.09  55.31
Exhst NOX:  1.89   2.36   2.42   2.39   5.27   1.31   1.44  13.02    .88   2.36
```

```
ot Stabilized Idle Emission Factors (Gm/Hr)
M-Id  HC: 16.29  23.34  23.65  23.47  25.12   1.83   6.94  16.64  64.01  18.04
idle  CO:159.27 196.75 196.62 196.70 247.95  12.68  21.32  48.64 160.59 160.76
Idle NOX:  2.65   2.82   2.76   2.79   2.81   9.84  11.91  16.63   2.40   3.34
```

```
al. Year: 1994            Region: Low           Altitude:  500. Ft.
                   I/M Program: Yes         Ambient Temp:   30.0 / 30.0 / 30.0 F
            Anti-tam. Program: No       Operating Mode:   50.0 / 10.0 / 50.0

994 1-HOUR STAN       ASTM Class: C
                  Minimum Temp: 20. (F)   Maximum Temp: 80. (F)
                      Base RVP: 13.5   In-use (IU) RVP: 13.5    IU 1st Yr: 1989

en. Type:  LDGV   LDGT1   LDGT2    LDGT    HDGV    LDDV    LDDT    HDDV    MC    All Veh
en. Spd.: 20.0    20.0    20.0            20.0    20.0    20.0    20.0    20.0
 MT Mix:    .705    .123    .085            .015    .020    .009    .031    .010

omposite Emission Factors (Gm/Mile)
o-Mth HC:  3.97   4.86   4.91   4.88   3.58    .53    .68   2.16   4.38   4.00
xhst  CO: 47.06  53.33  53.32  53.32  48.05   1.61   1.71  11.11  48.92  45.94
xnst NOX:  1.75   2.19   2.23   2.2    5.52   1.17   1.28  11.60    .96   2.18

ot Stabilized Idle Emission Factors (Gm/Hr)
M-Id  HC: 16.29  23.34  23.65  23.47  25.12   1.83   6.94  16.64  64.01  18.04
dle   CO:159.27 196.75 196.62 196.70 247.95  12.68  21.32  48.64 160.59 160.76
dle  NOX:  2.65   2.82   2.76   2.79   2.81   9.84  11.91  16.63   2.40   3.34
```

```
al. Year: 1994            Region: Low           Altitude:  500. Ft.
                   I/M Program: Yes         Ambient Temp:   30.0 / 30.0 / 30.0 F
            Anti-tam. Program: No       Operating Mode:   50.0 / 10.0 / 50.0

994 1-HOUR STAN       ASTM Class: C
                  Minimum Temp: 20. (F)   Maximum Temp: 80. (F)
                      Base RVP: 13.5   In-use (IU) RVP: 13.5    IU 1st Yr: 1989

en. Type:  LDGV   LDGT1   LDGT2    LDGT    HDGV    LDDV    LDDT    HDDV    MC    All Veh
en. Spd.: 25.0    25.0    25.0            25.0    25.0    25.0    25.0    25.0
 MT Mix:    .705    .123    .085            .015    .020    .009    .031    .010

omposite Emission Factors (Gm/Mile)
o-Mth HC:  3.18   3.90   3.93   3.91   2.66    .45    .57   1.81   3.76   3.21
xhst  CO: 37.81  42.95  42.63  42.82  37.70   1.27   1.35   8.78  39.01  36.89
xhst NOX:  1.65   2.06   2.09   2.07   5.76   1.08   1.18  10.70   1.06   2.06

t Stabilized Idle Emission Factors (Gm/Hr)
M-Id  HC: 16.29  23.34  23.65  23.47  25.12   1.83   6.94  16.64  64.01  18.04
dle   CO:159.27 196.75 196.62 196.70 247.95  12.68  21.32  48.64 160.59 160.76
dle  NOX:  2.65   2.82   2.76   2.79   2.81   9.84  11.91  16.63   2.40   3.34
```

```
al. Year: 1994            Region: Low           Altitude:  500. Ft.
                   I/M Program: Yes         Ambient Temp:   30.0 / 30.0 / 30.0 F
            Anti-tam. Program: No       Operating Mode:   20.6 / 27.3 / 20.6

994 8-HR GARAGE       ASTM Class: C
                  Minimum Temp: 20. (F)   Maximum Temp: 80. (F)
                      Base RVP: 13.5   In-use (IU) RVP: 13.5    IU 1st Yr: 1989

en. Type:  LDGV   LDGT1   LDGT2    LDGT    HDGV    LDDV    LDDT    HDDV    MC    All Veh
en. Spd.: 10.0    10.0    10.0            10.0    10.0    10.0    10.0    10.0
 MT Mix:    .705    .123    .085            .015    .020    .009    .031    .010

omposite Emission Factors (Gm/Mile)
o-Mth HC:  4.52   5.84   6.02   5.91   7.33    .72    .91   3.29   4.83   4.70
```

```
Exhst  CO: 46.51  54.19  56.91  55.30  92.04   2.54   2.75  20.39  64.89  47.11
Exhst NOX:  1.91   2.36   2.42   2.39   5.03   1.51   1.60  15.15    .96   2.45

Hot Stabilized Idle Emission Factors (Gm/Hr)
NM-Id  HC: 16.29  23.34  23.65  23.47  25.12   1.83   6.94  16.64  64.01  18.04
 Idle  CO:159.27 196.75 196.62 196.70 247.95  12.68  21.32  48.64 160.59 160.76
 Idle NOX:  2.65   2.82   2.76   2.79   2.81   9.84  11.91  16.63   2.40   3.34
_______________________________________________________________________________

Cal. Year: 1994          Region: Low          Altitude:  500. Ft.
                  I/M Program: Yes       Ambient Temp:   30.0 / 30.0 / 30.0 F
            Anti-tam. Program: No      Operating Mode:   20.6 / 27.3 / 20.6

1994 8-HOUR TEM        ASTM Class: C
                  Minimum Temp: 20. (F)   Maximum Temp: 80. (F)
                      Base RVP: 13.5   In-use (IU) RVP: 13.5   IU 1st Yr: 1989

Veh. Type:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV    MC   All Veh
Veh. Spd.: 15.0   15.0   15.0          15.0   15.0   15.0   15.0   15.0
  VMT Mix:   .705   .123   .085          .015   .020   .009   .031   .010

Composite Emission Factors (Gm/Mile)
Non-Mth HC:  3.00   3.91   3.99   3.95   5.01    .58    .73   2.64   3.43   3.15
Exhst  CO: 34.08  40.65  41.85  41.14  64.70   1.84   1.99  14.71  42.15  34.55
Exhst NOX:  1.74   2.15   2.20   2.17   5.27   1.29   1.38  13.02    .98   2.22

Hot Stabilized Idle Emission Factors (Gm/Hr)
NM-Id  HC: 16.29  23.34  23.65  23.47  25.12   1.83   6.94  16.64  64.01  18.04
 Idle  CO:159.27 196.75 196.62 196.70 247.95  12.68  21.32  48.64 160.59 160.76
 Idle NOX:  2.65   2.82   2.76   2.79   2.81   9.84  11.91  16.63   2.40   3.34
_______________________________________________________________________________

Cal. Year: 1994          Region: Low          Altitude:  500. Ft.
                  I/M Program: Yes       Ambient Temp:   30.0 / 30.0 / 30.0 F
            Anti-tam. Program: No      Operating Mode:   20.6 / 27.3 / 20.6

1994 8HR ALL IN        ASTM Class: C
                  Minimum Temp: 20. (F)   Maximum Temp: 80. (F)
                      Base RVP: 13.5   In-use (IU) RVP: 13.5   IU 1st Yr: 1989

Veh. Type:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV    MC   All Veh
Veh. Spd.: 20.0   20.0   20.0          20.0   20.0   20.0   20.0   20.0
  VMT Mix:   .705   .123   .085          .015   .020   .009   .031   .010

Composite Emission Factors (Gm/Mile)
Non-Mth HC:  2.25   2.95   2.99   2.97   3.58    .48    .60   2.16   2.79   2.37
Exhst  CO: 27.72  33.66  34.24  33.90  48.05   1.39   1.50  11.11  31.68  28.06
Exhst NOX:  1.62   1.99   2.04   2.01   5.52   1.15   1.23  11.60   1.07   2.05

Hot Stabilized Idle Emission Factors (Gm/Hr)
NM-Id  HC: 16.29  23.34  23.65  23.47  25.12   1.83   6.94  16.64  64.01  18.04
 Idle  CO:159.27 196.75 196.62 196.70 247.95  12.68  21.32  48.64 160.59 160.76
 Idle NOX:  2.65   2.82   2.76   2.79   2.81   9.84  11.91  16.63   2.40   3.34
_______________________________________________________________________________

Cal. Year: 1994          Region: Low          Altitude:  500. Ft.
                  I/M Program: Yes       Ambient Temp:   30.0 / 30.0 / 30.0 F
            Anti-tam. Program: No      Operating Mode:   20.6 / 27.3 / 20.6

1994 8HR STAN          ASTM Class: C
                  Minimum Temp: 20. (F)   Maximum Temp: 80. (F)
                      Base RVP: 13.5   In-use (IU) RVP: 13.5   IU 1st Yr: 1989

Veh. Type:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV    MC   All Veh
Veh. Spd.: 25.0   25.0   25.0          25.0   25.0   25.0   25.0   25.0
  VMT Mix:   .705   .123   .085          .015   .020   .009   .031   .010
```

```
Composite Emission Factors (Gm/Mile)
No-Mth HC:  1.81   2.37   2.39   2.38   2.66    .40    .50   1.81   2.39   1.91
Exhst  CO: 22.28  27.11  27.38  27.22  37.70   1.10   1.19   8.78  25.26  22.53
Exhst NOX:  1.53   1.88   1.92   1.89   5.76   1.06   1.13  10.70   1.18   1.94

Hot Stabilized Idle Emission Factors (Gm/Hr)
NM-Id  HC: 16.29  23.34  23.65  23.47  25.12   1.83   6.94  16.64  64.01  18.04
 Idle  CO:159.27 196.75 196.62 196.70 247.95  12.68  21.32  48.64 160.59 160.76
 Idle NOX:  2.65   2.82   2.76   2.79   2.81   9.84  11.91  16.63   2.40   3.34

Stop - Program terminated.
```

C.6 CAL3QHC Output

```
                         CAL3QHC: LINE SOURCE DISPERSION MODEL - MARCH, 1990 VERSION                         PAGE  1

  JOB: SHRINERS HOSPITAL AIR QUALITY                             RUN: CAMBRIDGE/STANIFORD 1991 EXISTING 1HR
  DATE: 10/15/1991    TIME: 13:19:45.32


   SITE & METEOROLOGICAL VARIABLES
   -------------------------------
   VS =     .0 CM/S        VD =     .0 CM/S       Z0 = 321. CM
    U =   1.0 M/S          CLAS =    4  (D)      ATIM =  60. MINUTES     MIXH =   850. M   AMB =  5.0 PPM

   LINK VARIABLES
   --------------
     LINK DESCRIPTION      *           LINK COORDINATES (M)            *   LENGTH  BRG TYPE   VPH    EF      H   W     V/C QUEUE
                           *   X1         Y1         X2        Y2      *    (M)    (DEG)           (G/MI)  (M) (M)         (VEH)
  -------------------------*---------------------------------------*-------------------------------------------------------------
   1. TEMPLE N IN          *     45.4       9.1       45.4    -390.8 *    400.    180. AG      5.  67.9   .3  9.8
   2. TEMPLE N LFT         *     25.9      18.3       45.4       9.1 *     22.    115. AG      2.  67.9   .3  9.8
   3. TEMPLE N STR         *     44.8      27.4       45.4       9.1 *     18.    178. AG      2.  67.9   .3  9.8
   4. TEMPLE N RHT         *     49.4       6.7       45.4       9.1 *      5.    302. AG      1.  67.9   .3  4.6
   5. TEMPLE N Q           *     45.4       9.1       45.4       8.6 *      1.    180. AG   1981. 100.0   .3  9.8  .02      .1
   6. STANIFORD S LFT IN   *     35.1      28.3       35.1     428.2 *    400.    360. AG    213.  54.5   .3  9.8
   7. STANIFORD S RHT IN   *     31.4      28.3       31.4     428.2 *    400.    360. AG    302.  54.5   .3  9.8
   8. STANIFORD S LFT      *     49.4       6.7       35.1      28.3 *     26.    326. AG    213.  67.9   .3  9.8
   9. STANIFORD S RHT      *     25.9      18.3       31.4      28.3 *     11.     29. AG    302.  67.9   .3  9.8
  10. STANIFORD S LFT Q    *     35.1      28.3       35.1      69.6 *     41.    360. AG   1981. 100.0   .3  9.8  .99     6.9
  11. STANIFORD S RHT Q    *     31.4      28.3       31.4      44.9 *     17.    360. AG   1098. 100.0   .3  9.8  .34     2.8
  12. STANIFORD N OUT      *     44.8     427.3       44.8      27.4 *    400.    180. AG    808.  43.8   .3 12.8
  13. CAMBRIDGE E LFT IN   *     24.7      11.3     -375.2      11.3 *    400.    270. AG    479.  95.8   .3  9.4
  14. CAMBRIDGE E STR IN   *     24.7       6.7     -375.2       6.7 *    400.    270. AG    811.  95.8   .3 12.8
  15. CAMBRIDGE E LFT      *     44.8      27.4       24.7      11.3 *     26.    231. AG    479.  67.9   .3  9.4
  16. CAMBRIDGE E STR      *     49.4       6.7       24.7       6.7 *     25.    270. AG    811.  67.9   .3 12.8
  17. CAMBRIDGE E LFT Q    *     24.7      11.3      -23.4      11.3 *     48.    270. AG   1504. 100.0   .3  9.4  .83     8.0
  18. CAMBRIDGE E STR Q    *     24.7       6.7       18.0       6.7 *      7.    270. AG    811. 100.0   .3 12.8  .28     1.1
  19. CAMBRIDGE E OUT      *    449.3       6.7       49.4       6.7 *    400.    270. AG   1025.  95.8   .3 12.8
  20. CAMBRIDGE W IN       *     50.6      18.3      450.5      18.3 *    400.     90. AG   1266.  95.8   .3 12.8
  21. CAMBRIDGE W STR      *     25.9      18.3       50.6      18.3 *     25.     90. AG    939.  67.9   .3 12.8
  22. CAMBRIDGE W RHT      *     44.8      27.4       50.6      18.3 *     11.    148. AG    327.  67.9   .3  9.4
  23. CAMBRIDGE W Q        *     50.6      18.3      105.7      18.3 *     55.     90. AG   2578. 100.0   .3 12.8  .86     9.2
  24. CAMBRIDGE W OUT      *   -374.0      18.3       25.9      18.3 *    400.     90. AG   1243.  67.9   .3 12.8

   RECEPTOR LOCATIONS
   ------------------
                           *         COORDINATES (M)          *
     RECEPTOR              *       X          Y          Z     *
  -------------------------*----------------------------------*
  1. BENCHES               *        68.6       46.6       1.8  *
  2. STORE 24              *        54.9        3.0       1.8  *
  3. SUN TUEY              *        21.6        3.0       1.8  *
  4. PLAYGROUND            *        18.3       71.9       1.8  *
```

```
JOB: SHRINERS HOSPITAL AIR QUALITY                      RUN: CAMBRIDGE/STANIFORD 1991 EXISTING 1HR

     MODEL RESULTS
     -------------

     REMARKS : In search of the angle corresponding to
               the maximum concentration, only the first
               angle, of the angles with same maximum
               concentrations, is indicated as maximum.

WIND ANGLE RANGE:  10.-360.

WIND   * CONCENTRATION
ANGLE  *      (PPM)
(DEGR)* REC1  REC2  REC3  REC4
------*------------------------
  10.  *   5.2  16.5  19.7   6.4
  20.  *   5.0  16.3  19.3   6.5
  30.  *   5.0  16.7  17.6   6.3
  40.  *   5.0  17.3  16.2   6.2
  50.  *   5.0  18.2  15.4   6.2
  60.  *   5.0  19.0  15.9   6.1
  70.  *   5.1  18.8  17.0   6.3
  80.  *   5.6  18.1  17.2   6.9
  90.  *   6.8  15.6  14.9   8.1
 100.  *   8.3  11.7  10.8  10.1
 110.  *   9.3   8.5   7.5  11.6
 120.  *   9.9   6.7   5.8  12.8
 130.  *  10.8   6.0   5.3  13.9
 140.  *  11.1   5.8   5.2  13.6
 150.  *  11.5   5.6   5.1  12.9
 160.  *  11.4   5.7   5.0  11.4
 170.  *  11.5   5.6   5.6   9.8
 180.  *  11.4   5.5   5.8   8.5
 190.  *  11.1   5.3   5.9   8.0
 200.  *  10.6   5.3   5.5   7.7
 210.  *  10.1   5.3   5.5   7.6
 220.  *  10.0   5.3   5.6   7.3
 230.  *  10.7   5.7   5.8   7.2
 240.  *  11.8   6.4   6.5   7.0
 250.  *  12.1   8.3   8.5   7.0
 260.  *  12.1  11.4  12.2   6.5
 270.  *  10.4  14.9  16.6   5.6
 280.  *   8.9  16.1  19.2   5.1
 290.  *   8.0  15.3  19.5   5.0
 300.  *   7.4  13.7  19.2   5.0
 310.  *   6.8  13.8  18.4   5.0
 320.  *   6.5  14.8  17.8   5.0
 330.  *   6.2  15.8  17.6   5.0
 340.  *   6.1  16.5  17.2   5.0
 350.  *   6.0  17.0  17.7   5.4
 360.  *   5.6  17.0  19.2   5.9
------*------------------------
MAX    *  12.1  19.0  19.7  13.9
DEGR.  *  250    60    10   130

Stop - Program terminated.
```

```
                          CAL3QHC: LINE SOURCE DISPERSION MODEL - MARCH, 1990 VERSION                          PAGE  1

JOB: SHRINERS HOSPITAL AIR QUALITY                           RUN: CAMBRIDGE/STANIFORD 1991 EXISTING 8HR
DATE: 10/15/1991   TIME: 13:21:05.57


 SITE & METEOROLOGICAL VARIABLES
 -------------------------------
 VS =    .0 CM/S          VD =     .0 CM/S        Z0 = 321. CM
  U =  1.0 M/S            CLAS =   4  (D)      ATIM =  60. MINUTES     MIXH =   850. M   AMB =  3.0 PPM

 LINK VARIABLES
 --------------
   LINK DESCRIPTION      *          LINK COORDINATES (M)             *   LENGTH  BRG TYPE   VPH    EF      H   W    V/C QUEUE
                         *   X1        Y1         X2         Y2      *    (M)   (DEG)             (G/MI)  (M) (M)       (VEH)
-------------------------*-------------------------------------------*----------------------------------------------------------
 1. TEMPLE N IN          *    45.4       9.1       45.4     -390.8 *    400.    180. AG      5.  41.8    .3  9.8
 2. TEMPLE N LFT         *    25.9      18.3       45.4        9.1 *     22.    115. AG      2.  41.8    .3  9.8
 3. TEMPLE N STR         *    44.8      27.4       45.4        9.1 *     18.    178. AG      2.  41.8    .3  9.8
 4. TEMPLE N RHT         *    49.4       6.7       45.4        9.1 *      5.    302. AG      1.  41.8    .3  4.6
 5. TEMPLE N Q           *    45.4       9.1       45.4        8.6 *      1.    180. AG   1222. 100.0    .3  9.8  .02     .1
 6. STANIFORD S LFT IN   *    35.1      28.3       35.1      428.2 *    400.    360. AG    166.  33.1    .3  9.8
 7. STANIFORD S RHT IN   *    31.4      28.3       31.4      428.2 *    400.    360. AG    236.  33.1    .3  9.8
 8. STANIFORD S LFT      *    49.4       6.7       35.1       28.3 *     26.    326. AG    166.  41.8    .3  9.8
 9. STANIFORD S RHT      *    25.9      18.3       31.4       28.3 *     11.     29. AG    236.  41.8    .3  9.8
10. STANIFORD S LFT Q    *    35.1      28.3       35.1       50.3 *     22.    360. AG   1222. 100.0    .3  9.8  .74    3.7
11. STANIFORD S RHT Q    *    31.4      28.3       31.4       41.1 *     13.    360. AG    677. 100.0    .3  9.8  .26    2.1
12. STANIFORD N OUT      *    44.8     427.3       44.8       27.4 *    400.    180. AG    631.  26.6    .3 12.8
13. CAMBRIDGE E LFT IN   *    24.7      11.3     -375.2       11.3 *    400.    270. AG    374.  33.1    .3  9.4
14. CAMBRIDGE E STR IN   *    24.7       6.7     -375.2        6.7 *    400.    270. AG    633.  33.1    .3 12.8
15. CAMBRIDGE E LFT      *    44.8      27.4       24.7       11.3 *     26.    231. AG    374.  41.8    .3  9.4
16. CAMBRIDGE E STR      *    49.4       6.7       24.7        6.7 *     25.    270. AG    633.  41.8    .3 12.8
17. CAMBRIDGE E LFT Q    *    24.7      11.3       -8.4       11.3 *     33.    270. AG    928. 100.0    .3  9.4  .65    5.5
18. CAMBRIDGE E STR Q    *    24.7       6.7       19.5        6.7 *      5.    270. AG    501. 100.0    .3 12.8  .22     .9
19. CAMBRIDGE E OUT      *   449.3       6.7       49.4        6.7 *    400.    270. AG    800.  33.1    .3 12.8
20. CAMBRIDGE W IN       *    50.6      18.3      450.5       18.3 *    400.     90. AG    987.  33.1    .3 12.8
21. CAMBRIDGE W STR      *    25.9      18.3       50.6       18.3 *     25.     90. AG    732.  41.8    .3 12.8
22. CAMBRIDGE W RHT      *    44.8      27.4       50.6       18.3 *     11.    148. AG    255.  41.8    .3  9.4
23. CAMBRIDGE W Q        *    50.6      18.3       87.3       18.3 *     37.     90. AG   1590. 100.0    .3 12.8  .67    6.1
24. CAMBRIDGE W OUT      *  -374.0      18.3       25.9       18.3 *    400.     90. AG    970.  33.1    .3 12.8

 RECEPTOR LOCATIONS
 ------------------
                         *         COORDINATES (M)          *
  RECEPTOR               *     X          Y            Z    *
-------------------------*----------------------------------*
1. BENCHES               *       68.6       46.6       1.8  *
2. STORE 24              *       54.9        3.0       1.8  *
3. SUN TUEY              *       21.6        3.0       1.8  *
4. PLAYGROUND            *       18.3       71.9       1.8  *
```

```
     MODEL RESULTS
     -------------

     REMARKS : In search of the angle corresponding to
               the maximum concentration, only the first
               angle, of the angles with same maximum
               concentrations, is indicated as maximum.

WIND ANGLE RANGE:  10.-360.

WIND   * CONCENTRATION
ANGLE  *       (PPM)
(DEGR)* REC1  REC2  REC3  REC4
------*------------------------
  10.  *   3.1   7.7   9.6   3.6
  20.  *   3.0   8.0   9.7   3.6
  30.  *   3.0   8.1   9.3   3.6
  40.  *   3.0   8.3   8.4   3.6
  50.  *   3.0   8.2   7.8   3.6
  60.  *   3.0   7.9   8.0   3.6
  70.  *   3.0   7.3   8.0   3.5
  80.  *   3.1   6.7   7.8   3.6
  90.  *   3.5   5.9   6.6   3.8
 100.  *   3.8   4.8   5.1   4.1
 110.  *   4.0   3.9   4.0   4.4
 120.  *   4.1   3.5   3.4   4.9
 130.  *   4.2   3.3   3.1   5.4
 140.  *   4.7   3.2   3.1   5.9
 150.  *   5.2   3.2   3.0   6.0
 160.  *   5.7   3.2   3.0   5.7
 170.  *   5.9   3.2   3.3   5.0
 180.  *   6.0   3.1   3.4   4.5
 190.  *   5.8   3.1   3.3   4.2
 200.  *   5.6   3.1   3.1   4.0
 210.  *   5.3   3.1   3.1   3.9
 220.  *   5.4   3.1   3.2   3.7
 230.  *   5.8   3.2   3.2   3.6
 240.  *   5.7   3.4   3.4   3.7
 250.  *   6.2   4.2   4.0   3.6
 260.  *   6.1   5.4   5.0   3.5
 270.  *   5.1   6.4   6.5   3.2
 280.  *   4.3   7.3   7.9   3.0
 290.  *   3.8   6.9   8.5   3.0
 300.  *   3.6   6.9   8.8   3.0
 310.  *   3.5   6.6   8.7   3.0
 320.  *   3.5   7.3   8.5   3.0
 330.  *   3.5   7.6   8.5   3.0
 340.  *   3.5   7.7   8.4   3.0
 350.  *   3.5   8.1   8.7   3.2
 360.  *   3.3   8.1   9.5   3.5
------*------------------------
MAX    *   6.2   8.3   9.7   6.0
DEGR.  *   250   40    20    150

Stop - Program terminated.
```

```
JOB: SHRINERS HOSPITAL AIR QUALITY                      RUN: CAMBRIDGE/STANIFORD 1994 NO BUILD 1HR
DATE: 10/15/1991    TIME: 13:22:19.44


 SITE & METEOROLOGICAL VARIABLES
 -------------------------------
 VS =    .0 CM/S       VO =    .0 CM/S       ZO = 321. CM
  U =  1.0 M/S         CLAS =   4  (D)     ATIM =  60. MINUTES     MIXH =   850. M   AMB =  5.0 PPM

 LINK VARIABLES
 --------------
  LINK DESCRIPTION      *          LINK COORDINATES (M)            *   LENGTH  BRG TYPE   VPH    EF       H   W     V/C QUEUE
                        *   X1         Y1         X2         Y2     *    (M)   (DEG)            (G/MI)   (M) (M)        (VEH)
------------------------*------------------------------------------*--------------------------------------------------------------
 1. TEMPLE N IN         *    45.4        9.1       45.4    -390.8 *    400.   180. AG      5.  55.3     .3  9.8
 2. TEMPLE N LFT        *    25.9       18.3       45.4       9.1 *     22.   115. AG      2.  55.3     .3  9.8
 3. TEMPLE N STR        *    44.8       27.4       45.4       9.1 *     18.   178. AG      2.  55.3     .3  9.8
 4. TEMPLE N RHT        *    49.4        6.7       45.4       9.1 *      5.   302. AG      1.  55.3     .3  4.6
 5. TEMPLE N Q          *    45.4        9.1       45.4       8.6 *      1.   180. AG   1523. 100.0     .3  9.8  .02      .1
 6. STANIFORD S LFT IN  *    35.1       28.3       35.1     428.2 *    400.   360. AG    219.  45.9     .3  9.8
 7. STANIFORD S RHT IN  *    31.4       28.3       31.4     428.2 *    400.   360. AG    311.  45.9     .3  9.8
 8. STANIFORD S LFT     *    49.4        6.7       35.1      28.3 *     26.   326. AG    219.  55.3     .3  9.8
 9. STANIFORD S RHT     *    25.9       18.3       31.4      28.3 *     11.    29. AG    311.  55.3     .3  9.8
10. STANIFORD S LFT Q   *    35.1       28.3       35.1      81.2 *     53.   360. AG   1523. 100.0     .3  9.8 1.01     8.8
11. STANIFORD S RHT Q   *    31.4       28.3       31.4      45.5 *     17.   360. AG    844. 100.0     .3  9.8  .35     2.9
12. STANIFORD N OUT     *    44.8      427.3       44.8      27.4 *    400.   180. AG    832.  36.9     .3 12.8
13. CAMBRIDGE E LFT IN  *    24.7       11.3     -375.2      11.3 *    400.   270. AG    493.  75.1     .3  9.4
14. CAMBRIDGE E STR IN  *    24.7        6.7     -375.2       6.7 *    400.   270. AG    848.  75.1     .3 12.8
15. CAMBRIDGE E LFT     *    44.8       27.4       24.7      11.3 *     26.   231. AG    493.  55.3     .3  9.4
16. CAMBRIDGE E STR     *    49.4        6.7       24.7       6.7 *     25.   270. AG    848.  55.3     .3 12.8
17. CAMBRIDGE E LFT Q   *    24.7       11.3      -26.3      11.3 *     51.   270. AG   1156. 100.0     .3  9.4  .86     8.5
18. CAMBRIDGE E STR Q   *    24.7        6.7       17.6       6.7 *      7.   270. AG    624. 100.0     .3 12.8  .30     1.2
19. CAMBRIDGE E OUT     *   449.3        6.7       49.4       6.7 *    400.   270. AG   1068.  75.1     .3 12.8
20. CAMBRIDGE W IN      *    50.6       18.3      450.5      18.3 *    400.    90. AG   1304.  75.1     .3 12.8
21. CAMBRIDGE W STR     *    25.9       18.3       50.6      18.3 *     25.    90. AG    967.  55.3     .3 12.8
22. CAMBRIDGE W RHT     *    44.8       27.4       50.6      18.3 *     11.   148. AG    337.  55.3     .3  9.4
23. CAMBRIDGE W Q       *    50.6       18.3      109.7      18.3 *     59.    90. AG   1981. 100.0     .3 12.8  .88     9.8
24. CAMBRIDGE W OUT     *  -374.0       18.3       25.9      18.3 *    400.    90. AG   1280.  55.3     .3 12.8

 RECEPTOR LOCATIONS
 ------------------
                        *        COORDINATES (M)          *
   RECEPTOR             *     X           Y           Z      *
------------------------*----------------------------------*
1. BENCHES              *      68.6        46.6        1.8  *
2. STORE 24             *      54.9         3.0        1.8  *
3. SUN TUEY             *      21.6         3.0        1.8  *
4. PLAYGROUND           *      18.3        71.9        1.8  *
```

```
JOB: SHRINERS HOSPITAL AIR QUALITY                    RUN: CAMBRIDGE/STANIFORD 1994 NO BUILD 1HR

     MODEL RESULTS
     -------------

     REMARKS : In search of the angle corresponding to
               the maximum concentration, only the first
               angle, of the angles with same maximum
               concentrations, is indicated as maximum.

WIND ANGLE RANGE:  10.-360.

WIND  * CONCENTRATION
ANGLE *      (PPM)
(DEGR)* REC1  REC2  REC3  REC4
------*------------------------
  10. *   5.1  14.2  16.9   6.1
  20. *   5.0  13.9  16.8   6.2
  30. *   5.0  14.3  15.4   6.3
  40. *   5.0  14.8  13.8   6.5
  50. *   5.0  15.5  13.5   6.9
  60. *   5.0  16.2  13.8   7.4
  70. *   5.1  16.2  14.7   8.0
  80. *   5.4  15.6  15.1   8.6
  90. *   6.5  13.7  13.2   9.3
 100. *   7.7  10.5   9.7  10.4
 110. *   8.6   7.8   7.1  11.2
 120. *   9.2   6.4   5.7  11.8
 130. *   9.7   5.8   5.3  12.0
 140. *  10.1   5.6   5.1  11.9
 150. *  10.0   5.5   5.1  10.9
 160. *  10.1   5.6   5.1   9.9
 170. *  10.1   5.5   5.5   8.9
 180. *  10.1   5.4   5.6   7.8
 190. *   9.9   5.3   5.7   7.5
 200. *   9.4   5.3   5.4   7.2
 210. *   9.1   5.2   5.4   7.1
 220. *   9.2   5.3   5.5   6.9
 230. *   9.7   5.5   5.8   6.8
 240. *  10.7   6.0   6.4   6.7
 250. *  10.7   7.8   8.0   6.7
 260. *  10.7  10.1  10.9   6.2
 270. *   9.4  13.1  14.5   5.6
 280. *   8.3  14.0  16.7   5.1
 290. *   7.6  13.2  16.8   5.0
 300. *   7.4  12.5  16.5   5.0
 310. *   7.1  12.3  15.9   5.0
 320. *   6.7  13.1  15.3   5.0
 330. *   6.3  13.9  15.1   5.0
 340. *   6.0  14.6  14.7   5.0
 350. *   5.9  14.9  15.3   5.3
 360. *   5.6  14.5  16.5   5.8
------*------------------------
MAX   *  10.7  16.2  16.9  12.0
DEGR. *  260    60    10   130

Stop - Program terminated.
```

```
                      CAL3QHC: LINE SOURCE DISPERSION MODEL - MARCH, 1990 VERSION                  PAGE  1

JOB: SHRINERS HOSPITAL AIR QUALITY                          RUN: CAMBRIDGE/STANIFORD 1994 NO BUILD 8HR
DATE: 10/15/1991   TIME: 13:23:27.66


 SITE & METEOROLOGICAL VARIABLES
 -------------------------------
 VS =    .0 CM/S        VD =    .0 CM/S       Z0 = 321. CM
  U =  1.0 M/S          CLAS =   4  (D)     ATIM =  60. MINUTES     MIXH =   850. M   AMB =  3.0 PPM

 LINK VARIABLES
 --------------
  LINK DESCRIPTION      *         LINK COORDINATES (M)          *  LENGTH  BRG TYPE   VPH    EF      H   W    V/C QUEUE
                        *   X1        Y1        X2        Y2    *   (M)   (DEG)            (G/MI)  (M) (M)        (VEH)
------------------------*---------------------------------------*----------------------------------------------------------
 1. TEMPLE N IN         *    45.4       9.1      45.4    -390.8 *   400.   180. AG     5.   34.6   .3  9.8
 2. TEMPLE N LFT        *    25.9      18.3      45.4       9.1 *    22.   115. AG     2.   34.6   .3  9.8
 3. TEMPLE N STR        *    44.8      27.4      45.4       9.1 *    18.   178. AG     2.   34.6   .3  9.8
 4. TEMPLE N RHT        *    49.4       6.7      45.4       9.1 *     5.   302. AG     1.   34.6   .3  4.6
 5. TEMPLE N Q          *    45.4       9.1      45.4       8.6 *     1.   180. AG   958.  100.0   .3  9.8  .02     .1
 6. STANIFORD S LFT IN  *    35.1      28.3      35.1     428.2 *   400.   360. AG   171.   28.1   .3  9.8
 7. STANIFORD S RHT IN  *    31.4      28.3      31.4     428.2 *   400.   360. AG   243.   28.1   .3  9.8
 8. STANIFORD S LFT     *    49.4       6.7      35.1      28.3 *    26.   326. AG   171.   34.6   .3  9.8
 9. STANIFORD S RHT     *    25.9      18.3      31.4      28.3 *    11.    29. AG   243.   34.6   .3  9.8
10. STANIFORD S LFT Q   *    35.1      28.3      35.1      51.4 *    23.   360. AG   958.  100.0   .3  9.8  .76    3.8
11. STANIFORD S RHT Q   *    31.4      28.3      31.4      41.5 *    13.   360. AG   531.  100.0   .3  9.8  .27    2.2
12. STANIFORD N OUT     *    44.8     427.3      44.8      27.4 *   400.   180. AG   650.   22.5   .3 12.8
13. CAMBRIDGE E LFT IN  *    24.7      11.3    -375.2      11.3 *   400.   270. AG   385.   28.1   .3  9.4
14. CAMBRIDGE E STR IN  *    24.7       6.7    -375.2       6.7 *   400.   270. AG   611.   28.1   .3 12.8
15. CAMBRIDGE E LFT     *    44.8      27.4      24.7      11.3 *    26.   231. AG   385.   34.6   .3  9.4
16. CAMBRIDGE E STR     *    49.4       6.7      24.7       6.7 *    25.   270. AG   611.   34.6   .3 12.8
17. CAMBRIDGE E LFT Q   *    24.7      11.3      -9.7      11.3 *    34.   270. AG   727.  100.0   .3  9.4  .67    5.7
18. CAMBRIDGE E STR Q   *    24.7       6.7      19.7       6.7 *     5.   270. AG   392.  100.0   .3 12.8  .21     .8
19. CAMBRIDGE E OUT     *   449.3       6.7      49.4       6.7 *   400.   270. AG   833.   28.1   .3 12.8
20. CAMBRIDGE W IN      *    50.6      18.3     450.5      18.3 *   400.    90. AG  1017.   28.1   .3 12.8
21. CAMBRIDGE W STR     *    25.9      18.3      50.6      18.3 *    25.    90. AG   754.   34.6   .3 12.8
22. CAMBRIDGE W RHT     *    44.8      27.4      50.6      18.3 *    11.   148. AG   263.   34.6   .3  9.4
23. CAMBRIDGE W Q       *    50.6      18.3      88.8      18.3 *    38.    90. AG  1246.  100.0   .3 12.8  .69    6.4
24. CAMBRIDGE W OUT     *  -374.0      18.3      25.9      18.3 *   400.    90. AG   999.   28.1   .3 12.8

 RECEPTOR LOCATIONS
 ------------------
                        *        COORDINATES (M)          *
  RECEPTOR              *     X          Y          Z     *
------------------------*---------------------------------*
1. BENCHES              *        68.6       46.6       1.8  *
2. STORE 24             *        54.9        3.0       1.8  *
3. SUN TUEY             *        21.6        3.0       1.8  *
4. PLAYGROUND           *        18.3       71.9       1.8  *
```

```
JOB: SHRINERS HOSPITAL AIR QUALITY                        RUN: CAMBRIDGE/STANIFORD 1994 NO BUILD 8HR

 MODEL RESULTS
 -------------

 REMARKS : In search of the angle corresponding to
           the maximum concentration, only the first
           angle, of the angles with same maximum
           concentrations, is indicated as maximum.

WIND ANGLE RANGE:  10.-360.

WIND  * CONCENTRATION
ANGLE *      (PPM)
(DEGR)* REC1  REC2  REC3  REC4
------*-----------------------
  10. *   3.1   6.9   8.5   3.5
  20. *   3.0   7.0   8.4   3.6
  30. *   3.0   7.1   7.9   3.6
  40. *   3.0   7.2   7.3   3.5
  50. *   3.0   7.3   7.0   3.5
  60. *   3.0   7.2   6.8   3.5
  70. *   3.0   6.8   7.0   3.4
  80. *   3.1   6.2   6.7   3.4
  90. *   3.4   5.5   5.9   3.6
 100. *   3.8   4.6   4.8   3.9
 110. *   3.8   3.8   3.9   4.1
 120. *   3.9   3.4   3.3   4.5
 130. *   4.2   3.2   3.1   5.1
 140. *   4.5   3.2   3.1   5.5
 150. *   4.9   3.1   3.0   5.4
 160. *   5.2   3.2   3.0   5.4
 170. *   5.4   3.1   3.2   4.6
 180. *   5.4   3.1   3.3   4.3
 190. *   5.3   3.1   3.3   4.0
 200. *   5.1   3.1   3.1   3.7
 210. *   4.9   3.1   3.1   3.7
 220. *   4.8   3.1   3.1   3.6
 230. *   5.0   3.2   3.2   3.6
 240. *   5.4   3.4   3.3   3.6
 250. *   5.5   3.9   3.8   3.6
 260. *   5.3   4.8   4.7   3.4
 270. *   4.8   5.8   6.0   3.1
 280. *   4.1   6.4   7.0   3.0
 290. *   3.7   6.2   7.5   3.0
 300. *   3.5   5.9   7.8   3.0
 310. *   3.4   6.0   7.6   3.0
 320. *   3.5   6.6   7.4   3.0
 330. *   3.5   6.8   7.4   3.0
 340. *   3.5   7.1   7.3   3.0
 350. *   3.5   7.3   7.6   3.2
 360. *   3.2   7.4   8.3   3.4
------*-----------------------
MAX   *   5.5   7.4   8.5   5.5
DEGR. *   250   360    10   140

Stop - Program terminated.
```

```
                     CAL3QHC: LINE SOURCE DISPERSION MODEL - MARCH, 1990 VERSION

JOB: SHRINERS HOSPITAL AIR QUALITY                    RUN: CAMBRIDGE/STANIFORD 1994 BUILD     1HR
DATE: 10/15/1991    TIME: 13:24:34.23


 SITE & METEOROLOGICAL VARIABLES
 -------------------------------
 VS =    .0 CM/S       VD =    .0 CM/S      Z0 = 321. CM
  U =  1.0 M/S         CLAS =   4  (D)     ATIM =  60. MINUTES    MIXH =   850. M   AMB =  5.0 PPM

 LINK VARIABLES
 --------------
  LINK DESCRIPTION     *        LINK COORDINATES (M)            *   LENGTH  BRG TYPE   VPH    EF      H   W    V/C QUEUE
                       *  X1        Y1        X2        Y2      *    (M)   (DEG)            (G/MI)  (M) (M)       (VEH)
-----------------------*----------------------------------------*-----------------------------------------------------------
 1. TEMPLE N IN        *    45.4      9.1      45.4    -390.8 *    400.   180. AG      5.  55.3   .3  9.8
 2. TEMPLE N LFT       *    25.9     18.3      45.4       9.1 *     22.   115. AG      2.  55.3   .3  9.8
 3. TEMPLE N STR       *    44.8     27.4      45.4       9.1 *     18.   178. AG      2.  55.3   .3  9.8
 4. TEMPLE N RHT       *    49.4      6.7      45.4       9.1 *      5.   302. AG      1.  55.3   .3  4.6
 5. TEMPLE N Q         *    45.4      9.1      45.4       8.6 *      1.   180. AG   1523. 100.0   .3  9.8  .02     .1
 6. STANIFORD S LFT IN *    35.1     28.3      35.1     428.2 *    400.   360. AG    220.  45.9   .3  9.8
 7. STANIFORD S RHT IN *    31.4     28.3      31.4     428.2 *    400.   360. AG    311.  45.9   .3  9.8
 8. STANIFORD S LFT    *    49.4      6.7      35.1      28.3 *     26.   326. AG    220.  55.3   .3  9.8
 9. STANIFORD S RHT    *    25.9     18.3      31.4      28.3 *     11.    29. AG    311.  55.3   .3  9.8
10. STANIFORD S LFT Q  *    35.1     28.3      35.1      84.4 *     56.   360. AG   1523. 100.0   .3  9.8 1.02    9.3
11. STANIFORD S RHT Q  *    31.4     28.3      31.4      45.5 *     17.   360. AG    844. 100.0   .3  9.8  .35    2.9
12. STANIFORD N OUT    *    44.8    427.3      44.8      27.4 *    400.   180. AG    832.  36.9   .3 12.8
13. CAMBRIDGE E LFT IN *    24.7     11.3    -375.2      11.3 *    400.   270. AG    493.  75.1   .3  9.4
14. CAMBRIDGE E STR IN *    24.7      6.7    -375.2       6.7 *    400.   270. AG    848.  75.1   .3 12.8
15. CAMBRIDGE E LFT    *    44.8     27.4      24.7      11.3 *     26.   231. AG    493.  55.3   .3  9.4
16. CAMBRIDGE E STR    *    49.4      6.7      24.7       6.7 *     25.   270. AG    848.  55.3   .3 12.8
17. CAMBRIDGE E LFT Q  *    24.7     11.3     -26.3      11.3 *     51.   270. AG   1156. 100.0   .3  9.4  .86    8.5
18. CAMBRIDGE E STR Q  *    24.7      6.7      17.6       6.7 *      7.   270. AG    624. 100.0   .3 12.8  .30    1.2
19. CAMBRIDGE E OUT    *   449.3      6.7      49.4       6.7 *    400.   270. AG   1069.  75.1   .3 12.8
20. CAMBRIDGE W IN     *    50.6     18.3     450.5      18.3 *    400.    90. AG   1304.  75.1   .3 12.8
21. CAMBRIDGE W STR    *    25.9     18.3      50.6      18.3 *     25.    90. AG    967.  55.3   .3 12.8
22. CAMBRIDGE W RHT    *    44.8     27.4      50.6      18.3 *     11.   148. AG    337.  55.3   .3  9.4
23. CAMBRIDGE W Q      *    50.6     18.3     109.7      18.3 *     59.    90. AG   1981. 100.0   .3 12.8  .88    9.8
24. CAMBRIDGE W OUT    *  -374.0     18.3      25.9      18.3 *    400.    90. AG   1280.  55.3   .3 12.8

 RECEPTOR LOCATIONS
 ------------------
                       *       COORDINATES (M)         *
  RECEPTOR             *     X          Y          Z   *
-----------------------*-------------------------------*
1. BENCHES             *      68.6       46.6       1.8  *
2. STORE 24            *      54.9        3.0       1.8  *
3. SUN TUEY            *      21.6        3.0       1.8  *
4. PLAYGROUND          *      18.3       71.9       1.8  *
```

```
JOB: SHRINERS HOSPITAL AIR QUALITY                    RUN: CAMBRIDGE/STANIFORD 1994 BUILD    1HR

 MODEL RESULTS
 -------------

 REMARKS : In search of the angle corresponding to
           the maximum concentration, only the first
           angle, of the angles with same maximum
           concentrations, is indicated as maximum.

WIND ANGLE RANGE:  10.-360.

WIND   * CONCENTRATION
ANGLE  *      (PPM)
(DEGR)*  REC1  REC2  REC3  REC4
------*------------------------
  10.  *   5.1  14.2  17.0   6.1
  20.  *   5.0  13.9  16.8   6.3
  30.  *   5.0  14.3  15.4   6.5
  40.  *   5.0  14.8  13.9   6.9
  50.  *   5.0  15.5  13.5   7.4
  60.  *   5.0  16.2  13.8   7.9
  70.  *   5.1  16.2  14.7   8.4
  80.  *   5.4  15.6  15.1   8.8
  90.  *   6.5  13.7  13.2   9.4
 100.  *   7.7  10.5   9.7  10.4
 110.  *   8.6   7.8   7.1  11.2
 120.  *   9.2   6.4   5.7  11.8
 130.  *   9.7   5.8   5.3  12.0
 140.  *  10.1   5.6   5.1  11.9
 150.  *  10.0   5.5   5.1  10.9
 160.  *  10.1   5.6   5.1   9.9
 170.  *  10.1   5.5   5.5   8.9
 180.  *  10.1   5.4   5.6   7.8
 190.  *   9.9   5.3   5.7   7.5
 200.  *   9.5   5.3   5.4   7.2
 210.  *   9.1   5.2   5.4   7.1
 220.  *   9.2   5.3   5.5   6.9
 230.  *   9.7   5.5   5.8   6.8
 240.  *  10.7   6.0   6.4   6.7
 250.  *  10.7   7.8   8.0   6.7
 260.  *  10.7  10.1  10.9   6.2
 270.  *   9.4  13.1  14.5   5.6
 280.  *   8.3  14.0  16.7   5.1
 290.  *   7.6  13.2  16.8   5.0
 300.  *   7.5  12.5  16.5   5.0
 310.  *   7.2  12.3  15.9   5.0
 320.  *   6.8  13.1  15.3   5.0
 330.  *   6.4  13.9  15.1   5.0
 340.  *   6.1  14.7  14.7   5.0
 350.  *   5.9  15.0  15.3   5.3
 360.  *   5.6  14.5  16.5   5.8
------*------------------------
MAX    *  10.7  16.2  17.0  12.0
DEGR.  *  260    60    10   130

Stop - Program terminated.
```

```
                          CAL3QHC: LINE SOURCE DISPERSION MODEL - MARCH, 1990 VERSION                          PAGE  1

  JOB: SHRINERS HOSPITAL AIR QUALITY                               RUN: CAMBRIDGE/STANIFORD 1994 BUILD    8HR
  DATE: 10/15/1991   TIME: 13:25:39.81


   SITE & METEOROLOGICAL VARIABLES
   -------------------------------
   VS =    .0 CM/S        VD =    .0 CM/S       Z0 = 321. CM
    U =  1.0 M/S          CLAS =   4  (D)     ATIM =  60. MINUTES     MIXH =   850. M   AMB =  3.0 PPM

   LINK VARIABLES
   --------------
    LINK DESCRIPTION      *            LINK COORDINATES (M)              *  LENGTH  BRG TYPE   VPH    EF       H    W    V/C QUEUE
                          *   X1         Y1         X2         Y2        *   (M)   (DEG)             (G/MI)   (M)  (M)        (VEH)
  ------------------------*------------------------------------------*------------------------------------------------------------
   1. TEMPLE N IN         *    45.4       9.1       45.4     -390.8 *    400.   180. AG      5.  34.6    .3  9.8
   2. TEMPLE N LFT        *    25.9      18.3       45.4        9.1 *     22.   115. AG      2.  34.6    .3  9.8
   3. TEMPLE N STR        *    44.8      27.4       45.4        9.1 *     18.   178. AG      2.  34.6    .3  9.8
   4. TEMPLE N RHT        *    49.4       6.7       45.4        9.1 *      5.   302. AG      1.  34.6    .3  4.6
   5. TEMPLE N Q          *    45.4       9.1       45.4        8.6 *      1.   180. AG    958. 100.0    .3  9.8  .02     .1
   6. STANIFORD S LFT IN  *    35.1      28.3       35.1      428.2 *    400.   360. AG    172.  28.1    .3  9.8
   7. STANIFORD S RHT IN  *    31.4      28.3       31.4      428.2 *    400.   360. AG    243.  28.1    .3  9.8
   8. STANIFORD S LFT     *    49.4       6.7       35.1       28.3 *     26.   326. AG    172.  34.6    .3  9.8
   9. STANIFORD S RHT     *    25.9      18.3       31.4       28.3 *     11.    29. AG    243.  34.6    .3  9.8
  10. STANIFORD S LFT Q   *    35.1      28.3       35.1       52.5 *     24.   360. AG    958. 100.0    .3  9.8  .80    4.0
  11. STANIFORD S RHT Q   *    31.4      28.3       31.4       41.5 *     13.   360. AG    531. 100.0    .3  9.8  .27    2.2
  12. STANIFORD N OUT     *    44.8     427.3       44.8       27.4 *    400.   180. AG    650.  22.5    .3 12.8
  13. CAMBRIDGE E LFT IN  *    24.7      11.3     -375.2       11.3 *    400.   270. AG    385.  28.1    .3  9.4
  14. CAMBRIDGE E STR IN  *    24.7       6.7     -375.2        6.7 *    400.   270. AG    611.  28.1    .3 12.8
  15. CAMBRIDGE E LFT     *    44.8      27.4       24.7       11.3 *     26.   231. AG    385.  34.6    .3  9.4
  16. CAMBRIDGE E STR     *    49.4       6.7       24.7        6.7 *     25.   270. AG    611.  34.6    .3 12.8
  17. CAMBRIDGE E LFT Q   *    24.7      11.3       -9.7       11.3 *     34.   270. AG    727. 100.0    .3  9.4  .67    5.7
  18. CAMBRIDGE E STR Q   *    24.7       6.7       19.7        6.7 *      5.   270. AG    392. 100.0    .3 12.8  .21     .8
  19. CAMBRIDGE E OUT     *   449.3       6.7       49.4        6.7 *    400.   270. AG    834.  28.1    .3 12.8
  20. CAMBRIDGE W IN      *    50.6      18.3      450.5       18.3 *    400.    90. AG   1017.  28.1    .3 12.8
  21. CAMBRIDGE W STR     *    25.9      18.3       50.6       18.3 *     25.    90. AG    754.  34.6    .3 12.8
  22. CAMBRIDGE W RHT     *    44.8      27.4       50.6       18.3 *     11.   148. AG    263.  34.6    .3  9.4
  23. CAMBRIDGE W Q       *    50.6      18.3       88.8       18.3 *     38.    90. AG   1246. 100.0    .3 12.8  .69    6.4
  24. CAMBRIDGE W OUT     *  -374.0      18.3       25.9       18.3 *    400.    90. AG    999.  28.1    .3 12.8

   RECEPTOR LOCATIONS
   ------------------
                          *           COORDINATES (M)            *
     RECEPTOR             *       X           Y           Z        *
  ------------------------*--------------------------------------*
  1. BENCHES              *       68.6        46.6        1.8     *
  2. STORE 24             *       54.9         3.0        1.8     *
  3. SUN TUEY             *       21.6         3.0        1.8     *
  4. PLAYGROUND           *       18.3        71.9        1.8     *
  MODEL RESULTS
  -------------

  REMARKS : In search of the angle corresponding to
            the maximum concentration, only the first
            angle, of the angles with same maximum
            concentrations, is indicated as maximum.

WIND ANGLE RANGE:  10.-360.

WIND  * CONCENTRATION
ANGLE *      (PPM)
(DEGR)* REC1  REC2  REC3  REC4
------*------------------------
  10. *  3.1   6.9   8.5   3.5
  20. *  3.0   7.0   8.4   3.6
  30. *  3.0   7.1   7.9   3.6
  40. *  3.0   7.2   7.3   3.5
  50. *  3.0   7.3   7.0   3.5
  60. *  3.0   7.2   6.8   3.5
  70. *  3.0   6.8   7.0   3.4
  80. *  3.1   6.2   6.7   3.4
  90. *  3.4   5.5   5.9   3.6
 100. *  3.8   4.6   4.8   3.9
 110. *  3.8   3.8   3.9   4.1
 120. *  3.9   3.4   3.3   4.5
 130. *  4.2   3.2   3.1   5.1
 140. *  4.5   3.2   3.1   5.6
 150. *  4.9   3.1   3.0   5.5
 160. *  5.2   3.2   3.0   5.5
 170. *  5.4   3.1   3.2   4.7
 180. *  5.4   3.1   3.3   4.3
 190. *  5.3   3.1   3.3   4.0
 200. *  5.1   3.1   3.1   3.7
 210. *  4.9   3.1   3.1   3.7
 220. *  4.8   3.1   3.1   3.6
 230. *  5.0   3.2   3.2   3.6
 240. *  5.4   3.4   3.3   3.6
 250. *  5.5   3.9   3.8   3.6
 260. *  5.3   4.8   4.7   3.4
 270. *  4.9   5.8   6.0   3.1
 280. *  4.2   6.4   7.0   3.0
 290. *  3.7   6.2   7.5   3.0
 300. *  3.5   6.0   7.8   3.0
 310. *  3.4   6.0   7.6   3.0
 320. *  3.5   6.6   7.4   3.0
 330. *  3.5   6.8   7.4   3.0
 340. *  3.5   7.1   7.3   3.0
 350. *  3.5   7.3   7.7   3.2
 360. *  3.2   7.4   8.3   3.4
------*------------------------
MAX   *  5.5   7.4   8.5   5.6
DEGR. *  250   360    10   140

Stop - Program terminated.
```

C.7 Garage Analysis Calculations

MODIFIED VOLUME 9 WORKSHEET 3
AREA SOURCE EMISSIONS FOR VENTILATED GARAGES*

Job No: 5582-2C1
Project Name: SHRINERS HOSPITAL
Site: Shriners garage
Case: Build 1-Hour 1994

Date: 9/13/91
By: MJS
Ch'k by:

(i)	MOVEMENT IDENTIFIER:	In	Out		
	1. Base Running Time				
	a. Distance (m)	134	134		
(S)	b. Vehicle Speed (mph)	10	10		
	c. Movement Time (s) (1a / (1b * 1609 m/mi * hr/3600s))	30.0	30.0		
	d. Additional Movement (s)	20	30		
	e. Total (s) (1c + 1d)	50	60		
(V)	2. Volume (veh/hr)	3	18		
	3. Excess Running Time				
	a. Opposing Volume	NA	737		
	b. Capacity (veh/hr) (Hwy Capacity Manual)	NA	487		
	c. Vol. to Capacity ratio	NA	0.04		
	d. Excess run time (s) {[2/(3b-2)] * 3600/3b}	NA	0.28		
(T)	4. Total Running Time (s/veh) (1e + 3d)	50	60.3		
(E)	5. Emissions (g/mi) (Mobile4)	75.08	75.08		
(Q)	6. Emission Rate (g/s)	0.072			

$\{ \sum(T_i*E_i*V_i*S_i) * (hr/3600s)^2 \}$

* Non-stadium, supervised garages, less than 95% occupied

MODIFIED VOLUME 9 WORKSHEET 3
AREA SOURCE EMISSIONS FOR VENTILATED GARAGES*

Job No: 5582-201
Project Name: Shriners Hosp.
Site: Shriners garage
Case: Build 8-Hour 1994

Date: 9/13/91
By: MJS
Ch'k by:

(i)	MOVEMENT IDENTIFIER:	In	Out		
	1. Base Running Time				
	a. Distance (m)	134	134		
(S)	b. Vehicle Speed (mph)	10	10		
	c. Movement Time (s) (1a/(1b * 1609 m/mi * hr/3600s))	30	30		
	d. Additional Movement (s)	20	30		
	e. Total (s) (1c + 1d)	50	60		
(V)	2. Volume (veh/hr)	12	19		
	3. Excess Running Time				
	a. Opposing Volume	NA	575		
	b. Capacity (veh/hr) (Hwy Capacity Manual)	NA	547		
	c. Vol. to Capacity ratio	NA	0.03		
	d. Excess run time (s) {[2/(3b-2)] * 3600/3b}	NA	0.24		
(T)	4. Total Running Time (s/veh) (1e + 3d)	50	60.2		
(E)	5. Emissions (g/mi) (Mobile4)	47.11	75.08		
(Q)	6. Emission Rate (g/s)	0.088			

$\{\sum(T_i * E_i * V_i * S_i) * (hr/3600s)^2\}$

---

* Non-stadium, supervised garages, less than 95% occupied

MODIFIED VOLUME 9 WORKSHEET 3
AREA SOURCE EMISSIONS FOR VENTILATED GARAGES*

Job No: 5582-201
Project Name: Shriners Hospital
Site: Shriners Garage
Case: Build - peak garage hour

Date: 9/13/91
By: MJS
Ch'k by:

(i)	MOVEMENT IDENTIFIER:	In	Out		
	1. Base Running Time				
	a. Distance (m)	134	134		
(S)	b. Vehicle Speed (mph)	10	10		
	c. Movement Time (s) (1a / 1b * 1609 m/mi * hr/3600s)	30	30		
	d. Additional Movement (s)	20	30		
	e. Total (s) (1c + 1d)	50	60		
(V)	2. Volume (veh/hr)	23	32		
	3. Excess Running Time				
	a. Opposing Volume	NA	575		
	b. Capacity (veh/hr) (Hwy Capacity Manual)	NA	547		
	c. Vol. to Capacity ratio	NA	0.06		
	d. Excess run time (s) {[2/(3b-2)] * 3600/3b}	NA	0.41		
(T)	4. Total Running Time (s/veh) (1e + 3d)	50	60.4		
(E)	5. Emissions (g/mi) (Mobile4)	47.11	75.08		
(Q)	6. Emission Rate (g/s)	0.154			

{$\sum(T_i*E_i*V_i*S_i)$ * (hr/3600s)^2}

---

* Non-stadium, supervised garages, less than 95% occupied

HMM ASSOCIATES, INC.
ENGINEERS, ENVIRONMENTAL CONSULTANTS & PLANNERS

JOB NO. 5582-201
SHEET NO. 1 OF 2
PROJECT Shriners Hospital
DATE 9/16/91
SUBJECT garage analysis
COMP. MJS CHECK

From Modified Worksheet 3

$Q_{1HR} = 0.072$

$Q_{8HR} = 0.088$

$Q_{peak} = 0.154$

concentration in ventilation exhaust

$X = 870\,(Q + (X_b)(F))/F$

$X_{b_{1HR}} = 5.75 \times 10^{-3}$

$X_{b_{8HR+peak}} = 3.45 \times 10^{-3}$

$F = 92{,}000 \text{ cfm} = \sim 43.42 \frac{m^3}{s}$

$X_{1HR} = 870\,(0.072 + (5.75 \times 10^{-3})(43.42))/43.42 = 6.45 \text{ ppm}$

$X_{8HR} = 870\,(0.088 + (3.45 \times 10^{-3})(43.42))/43.42 = 4.76 \text{ ppm}$

$X_{peak} = 870\,(0.154 + (3.45 \times 10^{-3})(43.42))/43.42 = 6.09 \text{ ppm}$

FIGURE

HMM ASSOCIATES, INC.

ENGINEERS, ENVIRONMENTAL CONSULTANTS & PLANNERS

PROJECT Shriners Hospital

SUBJECT garage analysis

JOB NO. 5582-201

SHEET NO. 2 OF 2

DATE 9/16/91

COMP. MJS CHECK

ambient concentrations

$$X_a = X/D$$

$$D = 2.22M[3.16 + (0.1S)/\sqrt{A_e}]^2 \frac{V}{V_e}$$

$$M = 40 \quad V = 10$$

$$V_e = 4342 \tfrac{m^3}{s} / 1672 m^2 = 260 \, m/s$$

$$\sqrt{A_e} = \sqrt{1672} = 409$$

$$D = 342\left(3.16 + \frac{0.1S}{409}\right)^2$$

Receptor	S(m)	D	X_{1HR}	$X_{a\,8HR}$	$X_{a\,peak}$
1	6.10	3745	0.2	0.1	02
2	79.25	88.37	0.1	0.1	0.1
3	64.01	76.35	0.1	0.1	0.1
4	36.58	56.22	0.1	0.1	0.1
5	97.54	105.15	0.1	0.0	0.1
6	48.77	64.79	0.1	0.1	0.1
7	22.86	47.30	0.1	0.1	0.1

FIGURE

```
                       CAL3QHC: LINE SOURCE DISPERSION MODEL - MARCH, 1990 VERSION                         PAGE  1

JOB: SHRINERS HOSPITAL AIR QUALITY                       RUN: BLOSSOM/OCONNELL 1994 BUILD NO QS 1HR
DATE: 09/20/1991   TIME: 10:59:03.05


 SITE & METEOROLOGICAL VARIABLES
 -------------------------------
 VS =    .0 CM/S         VD =    .0 CM/S        Z0 = 321. CM
  U =  1.0 M/S           CLAS =   4  (D)      ATIM =  60. MINUTES     MIXH =   850. M   AMB =  5.0 PPM

 LINK VARIABLES
 --------------
   LINK DESCRIPTION      *        LINK COORDINATES (M)         *    LENGTH  BRG TYPE   VPH    EF      H   W    V/C QUEUE
                         *  X1        Y1        X2        Y2   *     (M)   (DEG)            (G/MI)  (M) (M)        (VEH)
------------------------*--------------------------------------*------------------------------------------------------------
 1. BLOSSOM TO OCONNELL *        .0     -76.2        .0    129.5 *     206.   360. AG    741.  55.3    .3 21.3
 2. BLOSSOM 1           *        .0     129.5        .0    164.6 *      35.   360. AG    692.  55.3    .3 21.3
 3. BLOSSOM 2           *        .0     164.6     -32.0    182.9 *      37.   300. AG    692.  55.3    .3 21.3
 4. BLOSSOM 3           *     -32.0     182.9    -152.4    182.9 *     120.   270. AG    692.  55.3    .3 21.3
 5. CARDINAL OCONNELL 1 *        .0     129.5      79.2    129.5 *      79.    90. AG    403.  55.3    .3 15.2
 6. CARDINAL OCONNELL 2 *      79.2     129.5     140.2    106.7 *      65.   111. AG    403.  55.3    .3 15.2
 7. CARDINAL OCONNELL 3 *     140.2     106.7     137.2     30.5 *      76.   182. AG    403.  55.3    .3 15.2
 8. CARDINAL OCONNELL 4 *     137.2      30.5     213.4      6.1 *      80.   108. AG    403.  55.3    .3 15.2

 RECEPTOR LOCATIONS
 ------------------
                         *         COORDINATES (M)         *
   RECEPTOR              *      X          Y          Z     *
------------------------*----------------------------------*
1. RECEPTOR 1           *         9.1       88.4        1.8   *
2. RECEPTOR 2           *        45.7      161.5        1.8   *
3. RECEPTOR 3           *        76.2       71.6        1.8   *
4. RECEPTOR 4           *        21.3       56.4        1.8   *
5. RECEPTOR 5           *       -10.7         .0        1.8   *
6. RECEPTOR 6           *       -10.7       48.8        1.8   *
7. RECEPTOR 7           *       -10.7       88.4        1.8   *
```

```
JOB: SHRINERS HOSPITAL AIR QUALITY                    RUN: BLOSSOM/OCONNELL 1994 BUILD NO QS 1HR

     MODEL RESULTS
     -------------

     REMARKS : In search of the angle corresponding to
               the maximum concentration, only the first
               angle, of the angles with same maximum
               concentrations, is indicated as maximum.

WIND ANGLE RANGE:  10.-360.

WIND  * CONCENTRATION
ANGLE *      (PPM)
(DEGR)* REC1  REC2  REC3  REC4  REC5  REC6  REC7
------*------------------------------------------
  10. *   6.2   5.0   5.2   5.3   6.9   6.8   6.7
  20. *   5.7   5.0   5.2   5.2   6.8   6.8   6.9
  30. *   5.6   5.0   5.2   5.1   6.7   6.7   6.8
  40. *   5.5   5.0   5.2   5.2   6.5   6.5   6.8
  50. *   5.4   5.0   5.2   5.1   6.4   6.5   6.6
  60. *   5.4   5.0   5.2   5.1   6.3   6.3   6.5
  70. *   5.3   5.0   5.2   5.2   6.2   6.3   6.3
  80. *   5.2   5.0   5.2   5.1   6.2   6.2   6.3
  90. *   5.2   5.0   5.2   5.2   6.3   6.4   6.4
 100. *   5.1   5.1   5.3   5.2   6.1   6.2   6.2
 110. *   5.3   5.1   5.3   5.1   6.1   6.1   6.3
 120. *   5.2   5.4   5.3   5.0   6.2   6.2   6.3
 130. *   5.2   5.5   5.2   5.0   6.3   6.3   6.3
 140. *   5.2   5.6   5.1   5.0   6.4   6.4   6.4
 150. *   5.3   5.5   5.0   5.0   6.5   6.6   6.6
 160. *   5.6   5.3   5.0   5.0   6.6   6.7   6.8
 170. *   6.1   5.3   5.0   5.1   6.5   6.7   6.8
 180. *   6.8   5.5   5.0   5.4   6.2   6.4   6.5
 190. *   7.0   5.6   5.0   5.7   5.7   5.8   5.9
 200. *   6.9   5.8   5.1   5.9   5.3   5.4   5.4
 210. *   6.7   5.8   5.2   6.0   5.2   5.2   5.2
 220. *   6.5   5.8   5.3   6.0   5.1   5.1   5.1
 230. *   6.3   5.7   5.3   5.9   5.1   5.1   5.1
 240. *   6.2   5.6   5.3   5.9   5.1   5.1   5.1
 250. *   6.2   5.7   5.3   5.8   5.0   5.0   5.0
 260. *   6.2   5.7   5.3   5.8   5.0   5.0   5.0
 270. *   6.2   5.9   5.3   5.8   5.0   5.0   5.0
 280. *   6.2   5.8   5.3   5.8   5.0   5.0   5.0
 290. *   6.3   5.7   5.4   5.8   5.0   5.0   5.0
 300. *   6.4   5.3   5.6   6.0   5.1   5.1   5.2
 310. *   6.5   5.1   5.7   6.1   5.1   5.2   5.3
 320. *   6.9   5.0   5.6   6.1   5.2   5.3   5.4
 330. *   7.0   5.0   5.4   6.2   5.3   5.4   5.4
 340. *   7.2   5.0   5.2   6.2   5.5   5.6   5.7
 350. *   6.9   5.0   5.2   5.9   6.0   6.0   6.0
 360. *   6.8   5.0   5.2   5.6   6.6   6.5   6.4
------*------------------------------------------
MAX   *   7.2   5.9   5.7   6.2   6.9   6.8   6.9
DEGR. *  340   270   310   330    10    10    20

Stop - Program terminated.
```

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                    CAL3QHC: LINE SOURCE DISPERSION MODEL - MARCH, 1990 VERSION                       PAGE  1

JOB: SHRINERS HOSPITAL AIR QUALITY                           RUN: BLOSSOM/OCONNELL 1994 BUILD NO OS 8HR
DATE: 09/20/1991   TIME: 11:42:07.63


 SITE & METEOROLOGICAL VARIABLES
 -------------------------------
 VS =    .0 CM/S       VD =    .0 CM/S      Z0 = 321. CM
  U =  1.0 M/S        CLAS =   4  (D)     ATIM =  60. MINUTES     MIXH =   850. M   AMB =  3.0 PPM

 LINK VARIABLES
 --------------
   LINK DESCRIPTION      *          LINK COORDINATES (M)           *   LENGTH  BRG TYPE   VPH    EF      H   W    V/C QUEUE
                         *   X1        Y1         X2         Y2    *    (M)   (DEG)            (G/MI)  (M) (M)        (VEH)
-------------------------*-----------------------------------------*-----------------------------------------------------------
 1. BLOSSOM TO OCONNELL *       .0      -76.2        .0      129.5 *   206.   360. AG    578.  34.6    .3 21.3
 2. BLOSSOM 1           *       .0      129.5        .0      164.6 *    35.   360. AG    540.  34.6    .3 21.3
 3. BLOSSOM 2           *       .0      164.6     -32.0      182.9 *    37.   300. AG    540.  34.6    .3 21.3
 4. BLOSSOM 3           *    -32.0      182.9    -152.4      182.9 *   120.   270. AG    540.  34.6    .3 21.3
 5. CARDINAL OCONNELL 1 *       .0      129.5      79.2      129.5 *    79.    90. AG    314.  34.6    .3 15.2
 6. CARDINAL OCONNELL 2 *     79.2      129.5     140.2      106.7 *    65.   111. AG    314.  34.6    .3 15.2
 7. CARDINAL OCONNELL 3 *    140.2      106.7     137.2       30.5 *    76.   182. AG    314.  34.6    .3 15.2
 8. CARDINAL OCONNELL 4 *    137.2       30.5     213.4        6.1 *    80.   108. AG    314.  34.6    .3 15.2

 RECEPTOR LOCATIONS
 ------------------

                         *         COORDINATES (M)          *
   RECEPTOR              *     X           Y          Z     *
-------------------------*----------------------------------*
 1. RECEPTOR 1           *       9.1       88.4        1.8   *
 2. RECEPTOR 2           *      45.7      161.5        1.8   *
 3. RECEPTOR 3           *      76.2       71.6        1.8   *
 4. RECEPTOR 4           *      21.3       56.4        1.8   *
 5. RECEPTOR 5           *     -10.7         .0        1.8   *
 6. RECEPTOR 6           *     -10.7       -8.8        1.8   *
 7. RECEPTOR 7           *     -10.7       88.4        1.8   *
```

```
JOB: SHRINERS HOSPITAL AIR QUALITY                         RUN: BLOSSOM/OCONNELL 1994 BUILD NO QS 8HR

     MODEL RESULTS
     -------------

     REMARKS : In search of the angle corresponding to
               the maximum concentration, only the first
               angle, of the angles with same maximum
               concentrations, is indicated as maximum.

WIND ANGLE RANGE:  10.-360.

WIND   * CONCENTRATION
ANGLE  *      (PPM)
(DEGR)* REC1  REC2  REC3  REC4  REC5  REC6  REC7
------*------------------------------------------
  10.  *  3.6   3.0   3.1   3.1   3.9   3.9   3.9
  20.  *  3.3   3.0   3.1   3.1   3.8   3.9   3.9
  30.  *  3.2   3.0   3.1   3.1   3.8   3.9   3.9
  40.  *  3.2   3.0   3.1   3.0   3.7   3.8   3.8
  50.  *  3.2   3.0   3.1   3.1   3.6   3.6   3.7
  60.  *  3.2   3.0   3.1   3.1   3.6   3.6   3.7
  70.  *  3.1   3.0   3.1   3.0   3.5   3.5   3.6
  80.  *  3.1   3.0   3.1   3.0   3.6   3.6   3.6
  90.  *  3.0   3.0   3.1   3.0   3.6   3.6   3.6
 100.  *  3.0   3.0   3.1   3.0   3.6   3.6   3.6
 110.  *  3.0   3.1   3.2   3.0   3.5   3.5   3.5
 120.  *  3.1   3.1   3.2   3.0   3.6   3.6   3.6
 130.  *  3.1   3.2   3.1   3.0   3.6   3.6   3.6
 140.  *  3.1   3.2   3.0   3.0   3.7   3.7   3.7
 150.  *  3.2   3.1   3.0   3.0   3.8   3.8   3.8
 160.  *  3.3   3.1   3.0   3.0   3.8   3.8   3.9
 170.  *  3.6   3.2   3.0   3.1   3.7   3.8   3.9
 180.  *  3.9   3.3   3.0   3.2   3.6   3.7   3.7
 190.  *  4.0   3.4   3.0   3.3   3.3   3.4   3.4
 200.  *  3.9   3.4   3.1   3.5   3.2   3.2   3.2
 210.  *  3.8   3.4   3.1   3.5   3.1   3.1   3.1
 220.  *  3.7   3.3   3.2   3.5   3.1   3.1   3.1
 230.  *  3.7   3.4   3.2   3.4   3.1   3.1   3.1
 240.  *  3.6   3.3   3.2   3.4   3.0   3.0   3.0
 250.  *  3.6   3.2   3.2   3.4   3.0   3.0   3.0
 260.  *  3.6   3.4   3.2   3.4   3.0   3.0   3.0
 270.  *  3.6   3.3   3.2   3.4   3.0   3.0   3.0
 280.  *  3.6   3.5   3.2   3.4   3.0   3.0   3.0
 290.  *  3.6   3.2   3.1   3.4   3.0   3.0   3.0
 300.  *  3.7   3.2   3.2   3.4   3.0   3.0   3.1
 310.  *  3.7   3.0   3.4   3.5   3.1   3.1   3.2
 320.  *  3.8   3.0   3.2   3.5   3.1   3.2   3.2
 330.  *  4.0   3.0   3.1   3.5   3.2   3.2   3.2
 340.  *  4.0   3.0   3.1   3.6   3.3   3.3   3.3
 350.  *  4.1   3.0   3.1   3.4   3.4   3.4   3.6
 360.  *  3.9   3.0   3.1   3.3   3.7   3.8   3.6
------*------------------------------------------
MAX    *  4.1   3.5   3.4   3.6   3.9   3.9   3.9
DEGR.  *  350   280   310   340   10    10    10

Stop - Program terminated.
```

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                    CAL3QHC: LINE SOURCE DISPERSION MODEL   MARCH, 1990 VERSION                PAGE  1

JOB: SHRINERS HOSPITAL AIR QUALITY                        RUN: BLOSSOM/OCONNELL 1994 BUILD NO OS GARAGE
DATE: 09/20/1991   TIME: 13:16:27.15


 SITE & METEOROLOGICAL VARIABLES
 -------------------------------
 VS =    .0 CM/S       VD =    .0 CM/S       Z0 = 321. CM
  U =  1.0 M/S         CLAS =   4  (D)      ATIM =  60. MINUTES     MIXH =   850. M   AMB =  3.0 PPM

 LINK VARIABLES
 --------------
  LINK DESCRIPTION      *           LINK COORDINATES (M)            *   LENGTH  BRG TYPE   VPH    EF      H   W   V/C QUEUE
                        *   X1        Y1        X2        Y2        *    (M)   (DEG)             (G/MI)  (M) (M)       (VEH)
------------------------*-------------------------------------------*--------------------------------------------------------
 1. BLOSSOM TO OCONNELL *      .0     -76.2        .0     129.5 *     206.  360. AG    741.  34.6    .3 21.3
 2. BLOSSOM 1           *      .0     129.5        .0     164.6 *      35.  360. AG    692.  34.6    .3 21.3
 3. BLOSSOM 2           *      .0     164.6     -32.0     182.9 *      37.  300. AG    692.  34.6    .3 21.3
 4. BLOSSOM 3           *   -32.0     182.9    -152.4     182.9 *     120.  270. AG    692.  34.6    .3 21.3
 5. CARDINAL OCONNELL 1 *      .0     129.5      79.2     129.5 *      79.   90. AG    403.  34.6    .3 15.2
 6. CARDINAL OCONNELL 2 *    79.2     129.5     140.2     106.7 *      65.  111. AG    403.  34.6    .3 15.2
 7. CARDINAL OCONNELL 3 *   140.2     106.7     137.2      30.5 *      76.  182. AG    403.  34.6    .3 15.2
 8. CARDINAL OCONNELL 4 *   137.2      30.5     213.4       6.1 *      80.  108. AG    403.  34.6    .3 15.2

 RECEPTOR LOCATIONS
 ------------------
                        *         COORDINATES (M)          *
  RECEPTOR              *       X          Y          Z    *
------------------------*----------------------------------*
1. RECEPTOR 1           *         9.1       88.4       1.8  *
2. RECEPTOR 2           *        45.7      161.5       1.8  *
3. RECEPTOR 3           *        76.2       71.6       1.8  *
4. RECEPTOR 4           *        21.3       56.4       1.8  *
5. RECEPTOR 5           *       -10.7         .0       1.8  *
6. RECEPTOR 6           *       -10.7       48.8       1.8  *
7. RECEPTOR 7           *       -10.7       88.4       1.8  *
```

```
 MODEL RESULTS
 -------------

 REMARKS : In search of the angle corresponding to
           the maximum concentration, only the first
           angle, of the angles with same maximum
           concentrations, is indicated as maximum.

WIND ANGLE RANGE:  10.-360.

WIND   * CONCENTRATION
ANGLE  *      (PPM)
(DEGR)* REC1  REC2  REC3  REC4  REC5  REC6  REC7
------*----------------------------------------
  10.  *   3.8   3.0   3.1   3.1   4.1   4.2   4.1
  20.  *   3.5   3.0   3.1   3.1   4.2   4.2   4.1
  30.  *   3.4   3.0   3.1   3.1   4.0   4.1   4.1
  40.  *   3.3   3.0   3.1   3.2   3.9   4.0   4.1
  50.  *   3.2   3.0   3.1   3.1   3.8   3.9   4.0
  60.  *   3.3   3.0   3.2   3.1   3.7   3.8   3.8
  70.  *   3.2   3.0   3.1   3.0   3.7   3.7   3.9
  80.  *   3.1   3.0   3.1   3.1   3.7   3.7   3.8
  90.  *   3.1   3.0   3.1   3.1   3.8   3.8   3.8
 100.  *   3.1   3.0   3.1   3.1   3.7   3.7   3.7
 110.  *   3.0   3.1   3.2   3.1   3.7   3.7   3.7
 120.  *   3.1   3.1   3.2   3.0   3.7   3.7   3.7
 130.  *   3.1   3.3   3.1   3.0   3.8   3.8   3.8
 140.  *   3.1   3.3   3.0   3.0   3.9   3.9   3.9
 150.  *   3.2   3.2   3.0   3.0   4.0   4.0   4.0
 160.  *   3.4   3.2   3.0   3.0   4.0   4.1   4.1
 170.  *   3.7   3.2   3.0   3.1   3.9   4.1   4.1
 180.  *   4.1   3.3   3.0   3.2   3.8   3.9   3.9
 190.  *   4.2   3.4   3.0   3.4   3.4   3.5   3.5
 200.  *   4.2   3.5   3.1   3.6   3.2   3.2   3.3
 210.  *   4.1   3.5   3.2   3.6   3.1   3.1   3.1
 220.  *   4.0   3.6   3.2   3.6   3.1   3.1   3.1
 230.  *   3.8   3.4   3.2   3.6   3.1   3.1   3.1
 240.  *   3.8   3.4   3.2   3.5   3.1   3.1   3.1
 250.  *   3.7   3.2   3.2   3.5   3.0   3.0   3.0
 260.  *   3.7   3.4   3.2   3.5   3.0   3.0   3.0
 270.  *   3.8   3.6   3.2   3.5   3.0   3.0   3.0
 280.  *   3.7   3.5   3.[illegible] [illegible] 3.0   3.0   3.0
 290.  *   3.7   3.4   3.3   3.5   3.0   3.0   3.0
 300.  *   3.9   3.2   3.4   3.6   3.1   3.1   3.2
 310.  *   3.9   3.0   3.5   3.6   3.1   3.2   3.2
 320.  *   4.0   3.0   3.4   3.7   3.1   3.2   3.3
 330.  *   4.3   3.0   3.1   3.8   3.2   3.2   3.3
 340.  *   4.4   3.0   3.1   3.8   3.3   3.3   3.4
 350.  *   4.2   3.0   3.1   3.6   3.6   3.7   3.6
 360.  *   4.1   3.0   3.2   3.3   3.9   4.0   3.9
------*----------------------------------------
MAX    *   4.4   3.6   3.5   3.8   4.2   4.2   4.1
DEGR.  *  340   220   310   330    20    10    10

Stop - Program terminated.
```

C.8 References

1. EPA, User's Guide to MOBILE4: Mobile Source Emission Factor Model, EPA-AA-TEB-89-01, Ann Arbor, MI, February, 1989.

2. Personal Communication, Mr. Jon Anderson, Department of Environmental Protection (DEP), September 9, 1991.

3. Personal Communication, Mr. Richard Mertens, Boston Redevelopment Authority (BRA), September 6, 1991.

4. EPA Memorandum, "Adjustment of MOBILE4 Idle CO Emission Factors to Non-Standard Operating Conditions", Ann Arbor, MI, November 14, 1989.

5. Parsons Brinkerhoff Quade & Douglas, Inc., "User's Guide to CAL3QHC", September, 1990.

6. FHWA, CALINE3 - A Versatile Dispersion Model for Predicting Air Pollutant Levels Near Highways and Arterial Streets, FHWA/CA/TL-79/23, November, 1989.

7. Halitsky, J. "Gas Diffusion Near Buildings" Section 5-5, Meteorology and Atomic Energy - 1968, U.S. Atomic Energy Commission, July, 1968.

8. EPA, Guidelines for Air Quality Maintenance Planning and Analysis Volume 9 (Revised: Evaluating Indirect Sources, Second Printing, EPA-450/4-78-001, Research Triangle Park, North Carolina, September, 1978.

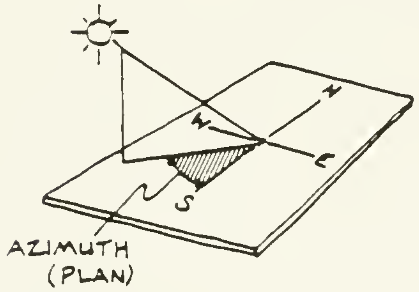
Appendix D

Solar Glare

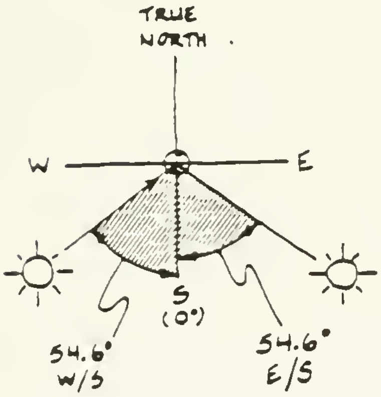
The following Appendix is from a procedure for estimating reflected sunlight provided by the BRA.

HOW TO DIAGRAM REFLECTED SUNLIGHT PATTERNS

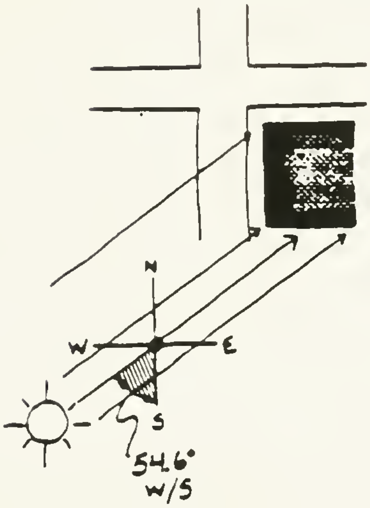
Identify month and time periods that are to be diagrammed (see Chart 1). Our major concern is when reflective (secondary) glare is visible within the average human cone of vision, defined as an angle 30 degrees above the horizontal.



A. To determine the angle at which sunlight is reflecting off the building face in plan, first find the azimuth for the appropriate time period/month (see Chart 1).

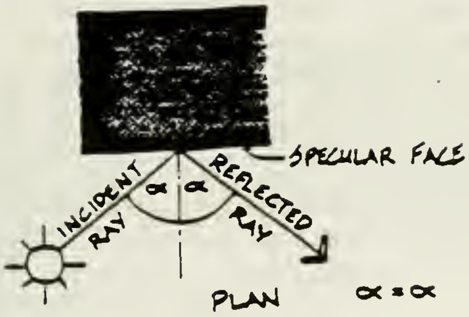


B. For example, for January 21 - 8:00 a.m. the azimuth is 54.6° east of south. For January 21 4:00 p.m. the azimuth is 54.6° west of south.

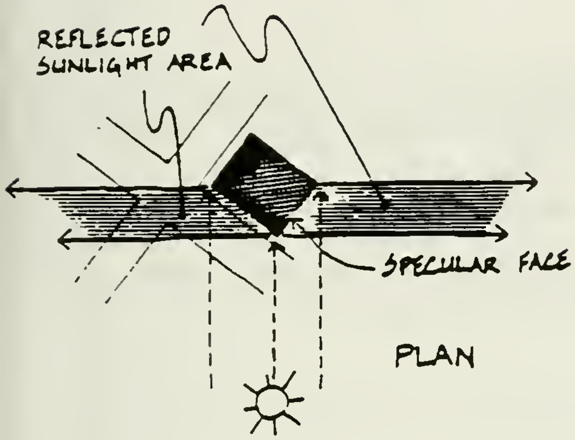


C. Take an area map showing the proposed structure in plan and overlay a true north compass. The appropriate azimuth angle should then be measured from the south arrow either west or ea

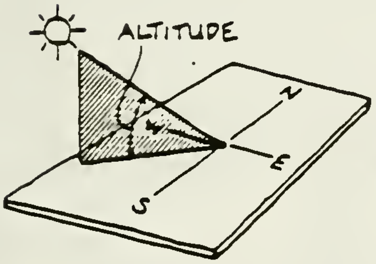
Once the sun's angle (azimuth) in plan is determined, extend parallel lines to the building faces that are exposed to the sun's rays.



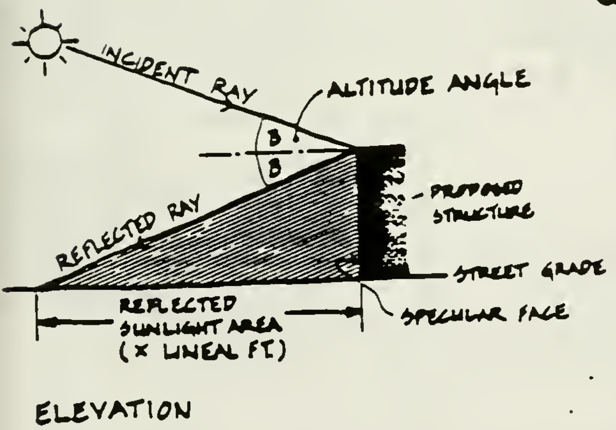
D. Since light is reflected off a specular surface at the same angle it strikes it (measured from an imaginary line perpendicular to the surface), we can determine its angle of reflectance with the horizontal if we know its angle of incidence relative to the horizontal.



E. The sun's rays should be projected to the corners of the building faces reflecting sunlight and the appropriate reflectance angles should be determined. This will define the width of the reflected sunlight only and not the length.



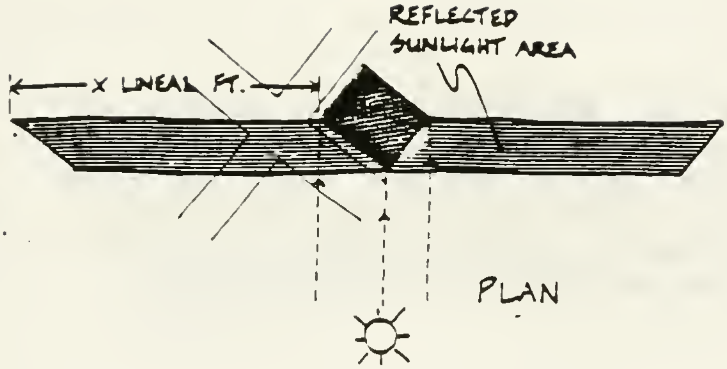
F. To determine the distance (length) that reflected sunlight is projected, identify the appropriate altitude angle for the time period we are diagramming for (see Chart 1).



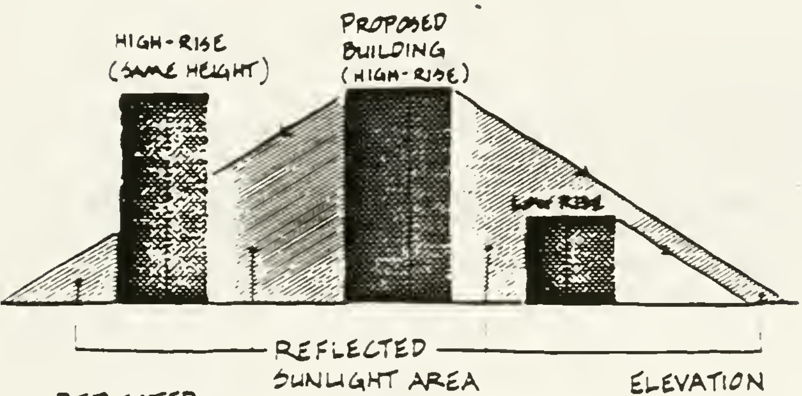
G. Since light is reflected off a specular surface at the same angle it strikes it, we can determine its angle of reflectance with the horizontal in elevation and thereby determine where it strikes grade and the distance away from the building that it may impact pedestrians.

In an elevation drawing (to scale), locate your proposed building with the grade line.

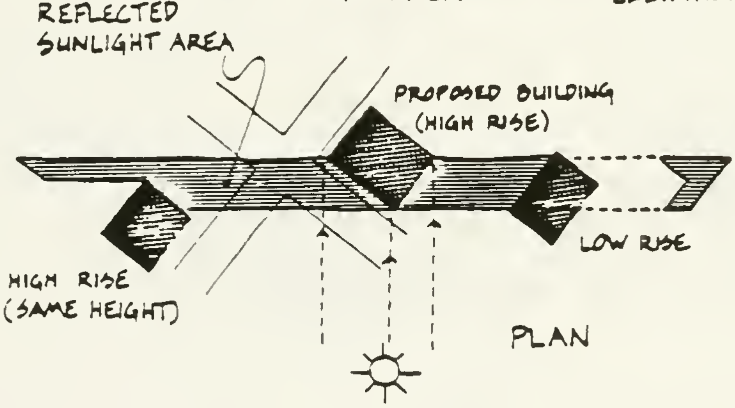
Project the sun's ray, using the appropriate altitude angle to the highest point of the structure which will reflect sunlight. Extend the reflected ray until it intersects grade level. Measure the distance from the building's face to the intersecting point to determine the reflective sunlight area.

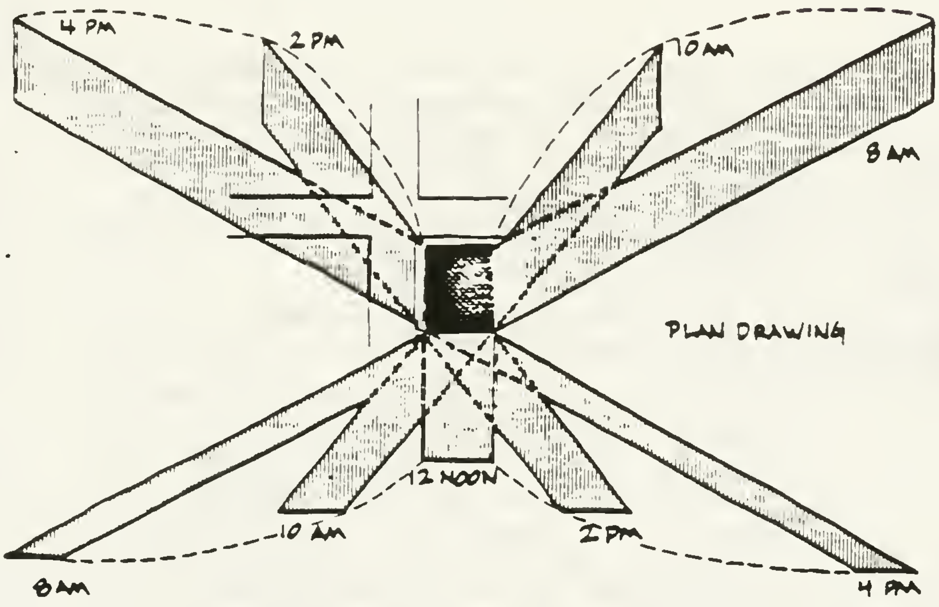


H. Referring back to drawing E. (azimuth
and reflectance angle in plan), take t
measured distance determined in drawin
G. and scale along the reflecting
angles extending from the corners of t
building. A parallel line to the buil
ing face reflecting light should resul
delineating the reflected sunlight are



I. Important Note: When the reflected su
light area is diagrammed, superimpose
adjacent buildings which will intercep
reflected sunlight rays. Use elevatic
drawing showing actual height of build
ings to determine reflected sunlight
areas and transpose to plan drawing.





J. Continue to follow the
same procedure for othe
times of the same day
to develop a composite
reflected sunlight
diagram.

Note: By interconnectir
diagrams for different
time periods of the day
overall solar reflectiv
spot glare pattern is
determined.

CHART 1 48° Latitude

DATE	TIME		SOLAR POSITION	
	SOLAR	DAYLIGHT SAVING	ALTITUDE	AZIMUTH
JAN 21	• 8 AM		3.5°	54.6° E/S
	• 9		11.0°	42.6° E/S
	• 10		16.9°	29.4° E/S
	• 11		20.7°	15.1° E/S
	• 12		22.0°	0.0°
	• 1 PM		20.7°	15.1° W/S
	• 2		16.9°	29.4° W/S
	• 3		11.0°	42.6° W/S
	• 4		3.5°	54.6° W/S
FEB 21	• 7 AM		2.4°	72.2° E/S
	• 8		11.6°	60.5° E/S
	• 9		19.7°	47.7° E/S
	• 10		26.2°	33.3° E/S
	• 11		30.5°	17.2° E/S
	12		32.0°	0.0°
	• 1 PM		30.5°	17.2° W/S
	• 2		26.2°	33.3° W/S
	• 3		18.7°	47.7° W/S
	• 4		11.7°	60.5° W/S
	• 5		2.4°	72.2° W/S
MARCH 21	• 7 AM		10.0°	78.7° E/S
	• 8		19.5°	66.8° E/S
	• 9		28.2°	53.4° E/S
	10		35.4°	37.8° E/S
	11		40.3°	19.8° E/S
	12		42.0°	0.0°
	1 PM		40.3°	19.8° W/S
	2		35.4°	37.8° W/S
	• 3		28.2°	53.4° W/S
	• 4		19.5°	66.8° W/S
	• 5		10.8°	78.7° W/S
APR 21	• 6 AM		8.6°	97.8° E/S
	• 7		18.6°	86.7° E/S
	• 8		28.5°	74.9° E/S
	9		37.8°	61.7° E/S
	10		45.0°	44.6° E/S
	11		51.5°	24.0° E/S
	12		53.6°	0.0°
	1 PM		51.5°	24.0° W/S
	2		45.0°	44.6° W/S
	3		37.8°	61.2° W/S
	• 4		28.5°	74.9° W/S
	• 5		18.6°	86.1° W/S
	• 6		8.6°	97.8° W/S

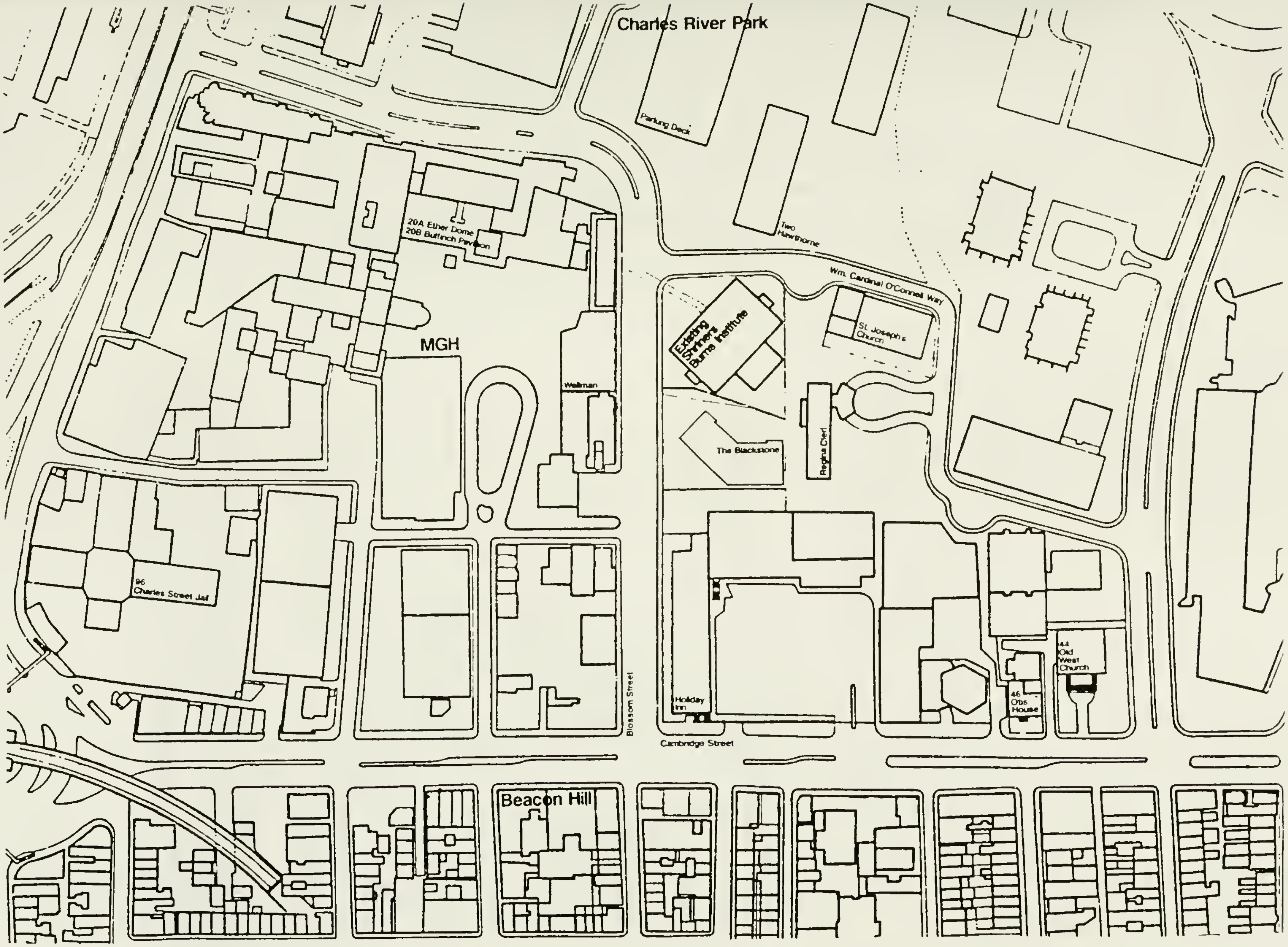
DATE	TIME		SOLAR POSITION	
	SOLAR	DAYLIGHT SAVING	ALTITUDE	AZIMUTH
MAY 21	• 5 AM	6 AM	5.2°	114.3° E/S
	• 6	7	14.7°	103.7° E/S
	• 7	8	24.6°	93.0° E/S
	• 8	9	34.7°	81.6° E/S
	9	10	44.3°	68.3° E/S
	10	11	53.0°	51.3° E/S
	11	12	59.5°	28.6° E/S
	12	1 PM	62.0°	0.0°
	1 PM	2	59.5°	28.6° W/S
	2	3	53.0°	51.3° W/S
	3	4	44.3°	68.3° W/S
	4	5	34.7°	81.6° W/S
	• 5	6	24.6°	93.0° W/S
	• 6	7	14.7°	103.7° W/S
	• 7	8	5.2°	114.3° W/S
JUNE 21	• 5 AM	6 AM	7.9°	116.5° E/S
	• 6	7	17.2°	106.2° E/S
	• 7	8	27.0°	95.8° E/S
	8	9	37.1°	84.6° E/S
	9	10	46.9°	71.6° E/S
	10	11	55.8°	54.8° E/S
	11	12	62.7°	31.2° E/S
	12	1 PM	65.5°	0.0°
	1 PM	2	62.7°	31.2° W/S
	2	3	55.8°	54.8° W/S
	3	4	46.9°	71.6° W/S
	4	5	37.1°	84.6° W/S
	• 5	6	27.0°	95.8° W/S
	• 6	7	17.2°	106.2° W/S
	• 7	8	7.9°	116.5° W/S
JULY 21	• 5 AM	6 AM	5.7°	114.7° E/S
	• 6	7	15.2°	104.1° E/S
	• 7	8	25.1°	93.5° E/S
	8	9	35.1°	82.1° E/S
	9	10	44.8°	68.8° E/S
	10	11	53.5°	51.8° E/S
	11	12	60.1°	28.8° E/S
	12	1 PM	62.6°	0.0°
	1 PM	2	60.1°	28.8° W/S
	2	3	53.5°	51.8° W/S
	3	4	44.8°	68.8° W/S
	4	5	35.1°	82.1° W/S
	• 5	6	25.1°	93.5° W/S
	• 6	7	15.2°	104.1° W/S
	• 7	8	5.7°	114.7° W/S
AUG 21	• 6 AM	7 AM	9.1°	98.3° E/S
	• 7	8	19.1°	87.2° E/S
	• 8	9	29.1°	75.4° E/S
	9	10	38.4°	61.6° E/S
	10	11	46.4°	45.1° E/S
	11	12	52.5°	24.3° E/S
	12	1 PM	54.3°	0.0°
	1 PM	2	52.2°	24.1° W/S
	2	3	46.4°	45.1° W/S
	3	4	38.4°	61.8° W/S
	• 4	5	29.1°	75.4° W/S
	• 5	6	19.1°	87.4° W/S
	• 6	7	9.1°	98.3° W/S

DATE	TIME		SOLAR POSITION	
	SOLAR	DAYLIGHT SAVING	ALTITUDE	AZIMUTH
SEPT 21	• 7 AM	8 AM	10.0°	78.7° E/S
	• 8	9	14.5°	66.8° E/S
	• 9	10	28.2°	53.4° E/S
	10	11	35.4°	37.8° E/S
	11	12	40.3°	19.8° E/S
	12	1 PM	42.0°	0.0°
	1 PM	2	40.3°	19.8° W/S
	2	3	35.4°	37.8° W/S
	• 3	4	28.2°	53.4° W/S
	• 4	6	19.5°	66.8° W/S
	• 5	6	10.0°	78.7° W/S
OCT 21	• 7 AM		2.0°	71.9° E/S
	• 8		11.2°	60.2° E/S
	• 9		19.3°	47.4° E/S
	• 10		25.7°	33.1° E/S
	11		30.0°	17.1° E/S
	12		31.5°	0.0°
	1 PM		30.0°	17.1° W/S
	• 2		25.7°	33.1° W/S
	• 3		19.3°	47.4° W/S
	• 4		11.2°	60.2° W/S
	• 5		2.0°	71.9° W/S
NOV 21	• 8 AM		3.6°	54.7° E/S
	• 9		11.2°	42.7° E/S
	• 10		17.1°	24.5° E/S
	• 11		20.9°	15.1° E/S
	• 12		22.2°	0.0°
	• 1 PM		20.9°	15.1° W/S
	• 2		17.1°	29.5° W/S
	• 3		11.2°	42.7° W/S
	• 4		3.6°	54.7° W/S
DEC 21	• 8AM		2°	52.0° E/S
	• 9		8.0°	40.9° E/S
	• 10		13.6°	28.2° E/S
	• 11		17.3°	144.4° E/S
	• 12		18.6°	0.0°
	• 1 PM		17.3°	14.4° W/S
	• 2		13.3°	28.2° W/S
	• 3		8.0°	40.9° W/S
	• 4		2.0°	52.0° W/S

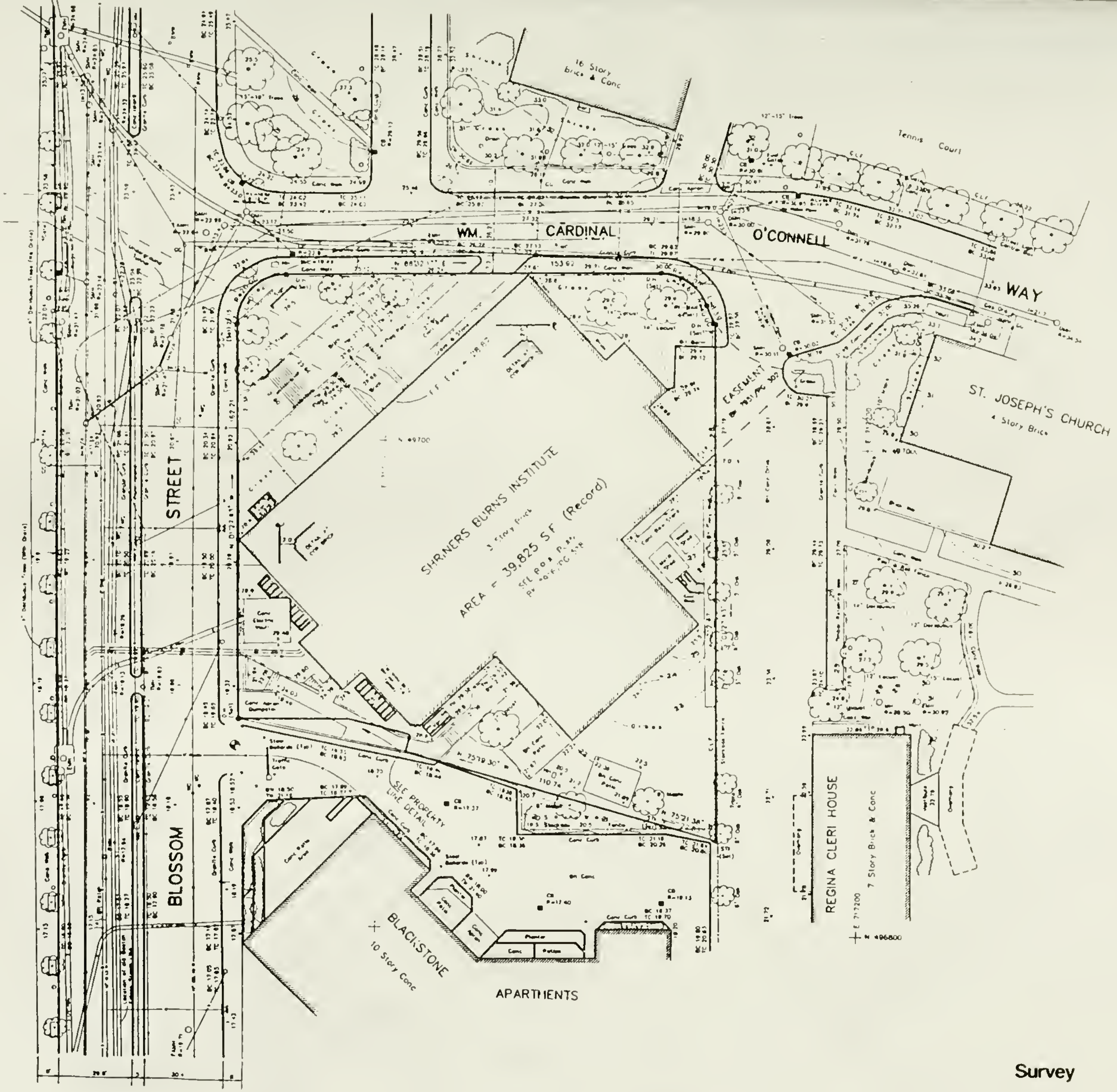
• TIME PERIOD WHEN ALTITUDE IS LESS THAN 30 DEGREES ABOVE THE HORIZON.

Appendix E

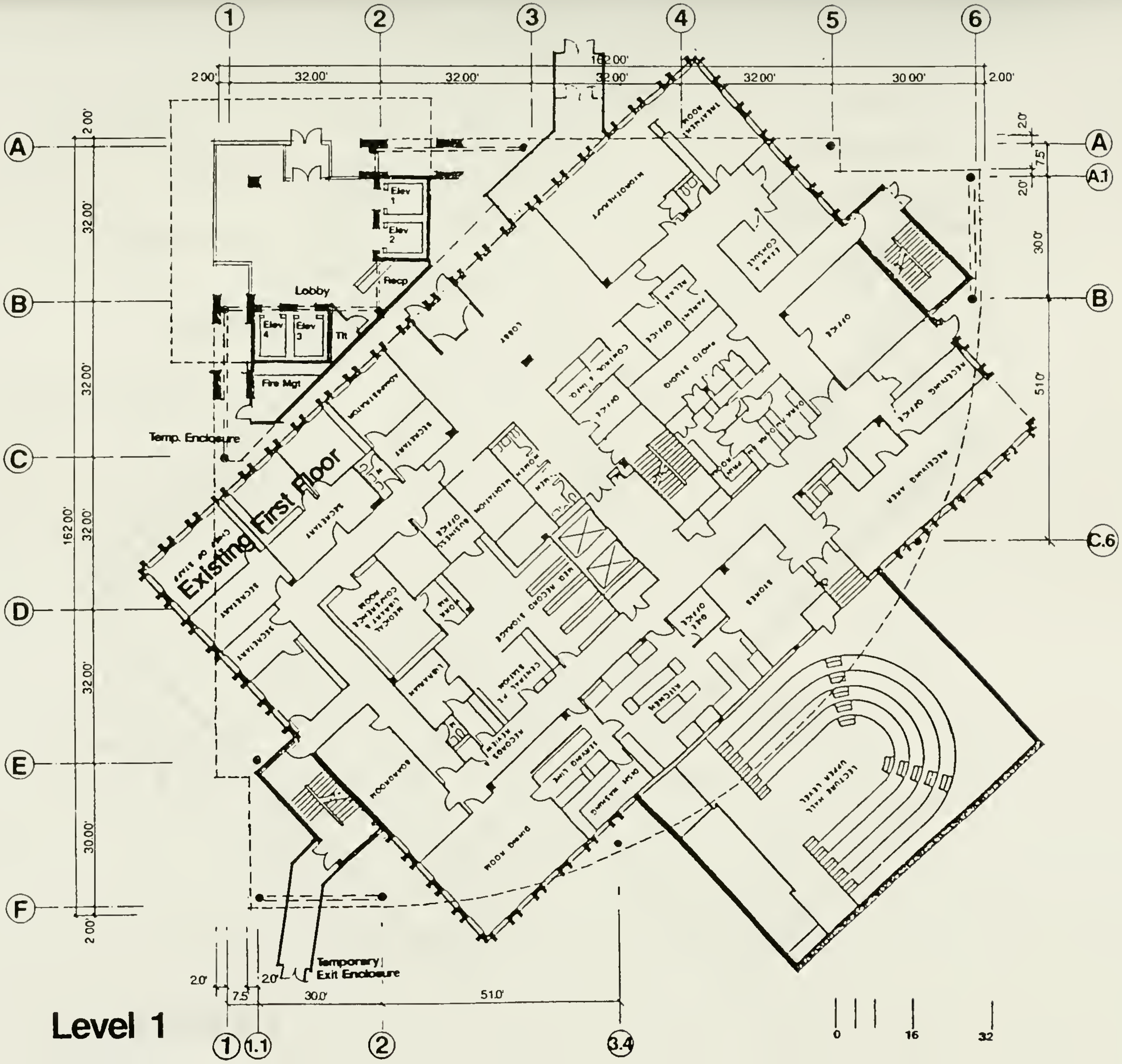
Revised Schematic Design Submission



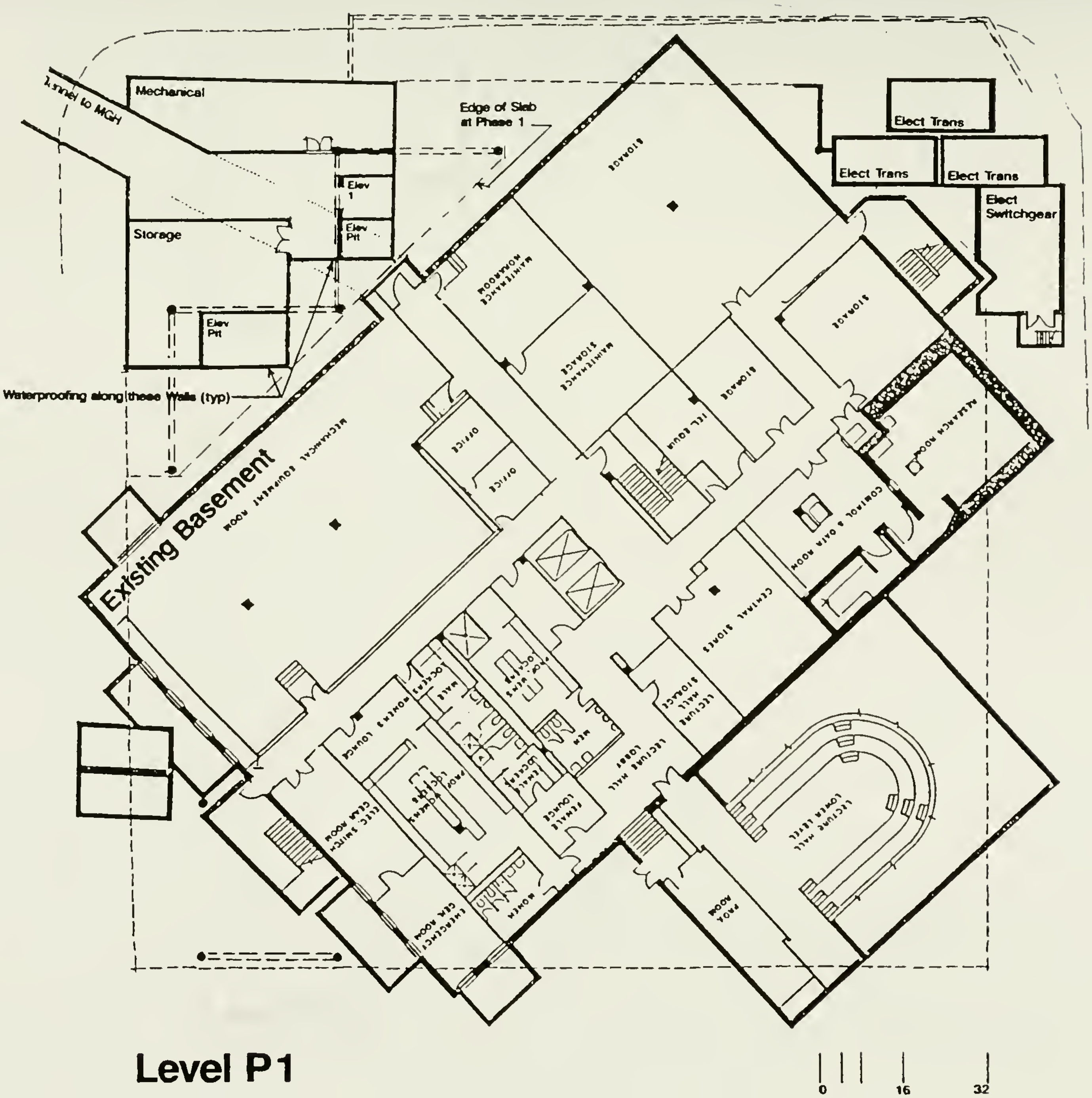
Location Plan


WM. CARDINAL O'CONNELL WAY
16 Story Brick & Conc
Tennis Court
ST. JOSEPH'S CHURCH
4 Story Brick
EASEMENT
SHRINERS BURNS INSTITUTE
3 Story Brick
AREA = 39,825 S.F. (Record)
STREET
BLOSSOM
SEE PROPERTY LINE DETAIL
BLACKSTONE
10 Story Conc
APARTMENTS
REGINA CLERI HOUSE
7 Story Brick & Conc

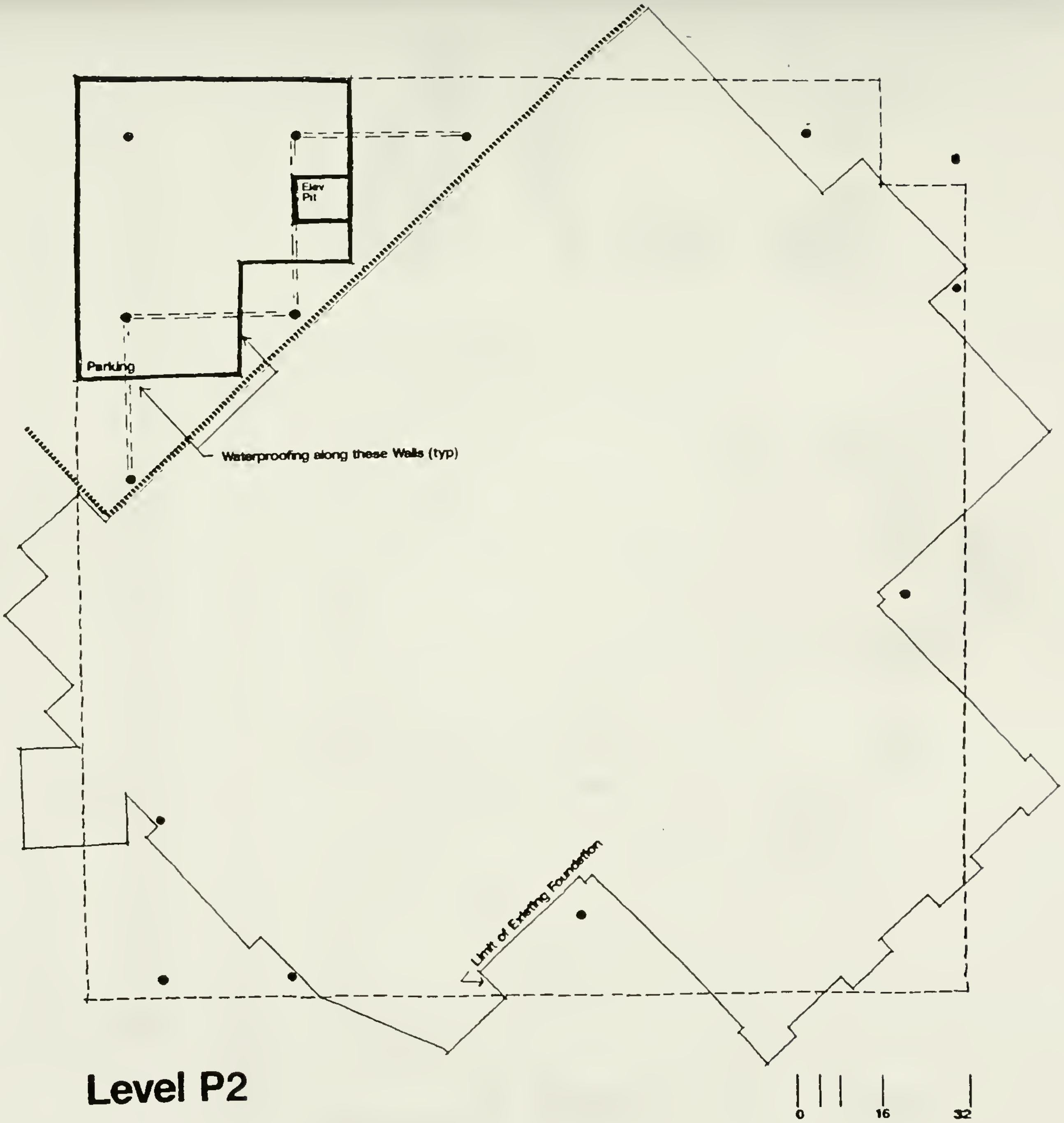
Survey


1
2
3
4
5
6
1.1
3.4
A
A.1
B
C
C.6
D
E
F
162.00'
2.00'
32.00'
32.00'
32.00'
32.00'
30.00'
2.00'
2.0'
7.5'
2.0'
30.0'
51.0'
Elev 1
Elev 2
Elev 3
Elev 4
Recp
Lobby
Tlt
Fire Mgt
Temp. Enclosure
Temporary Exit Enclosure
Existing First Floor
Treatment Room
Hydrotherapy
Exam & Consult
Office
Receiving Office
Receiving Area
Darkroom
Print Room
Photo Studio
Parent
Relax
Office
Control & Info
Office
Lobby
Men
Women
Meditation
Med Record Storage
Central PE Station
Records & Review
Business Office
Work Rm
Medical Library & Conference Room
Librarian
Stores
QC Office
Kitchen
Dish Washing
Serving Line
Dining Room
Boardroom
Secretary
Secretary
Secretary
Secretary
Administrator
Lecture Hall Upper Level
0
16
32

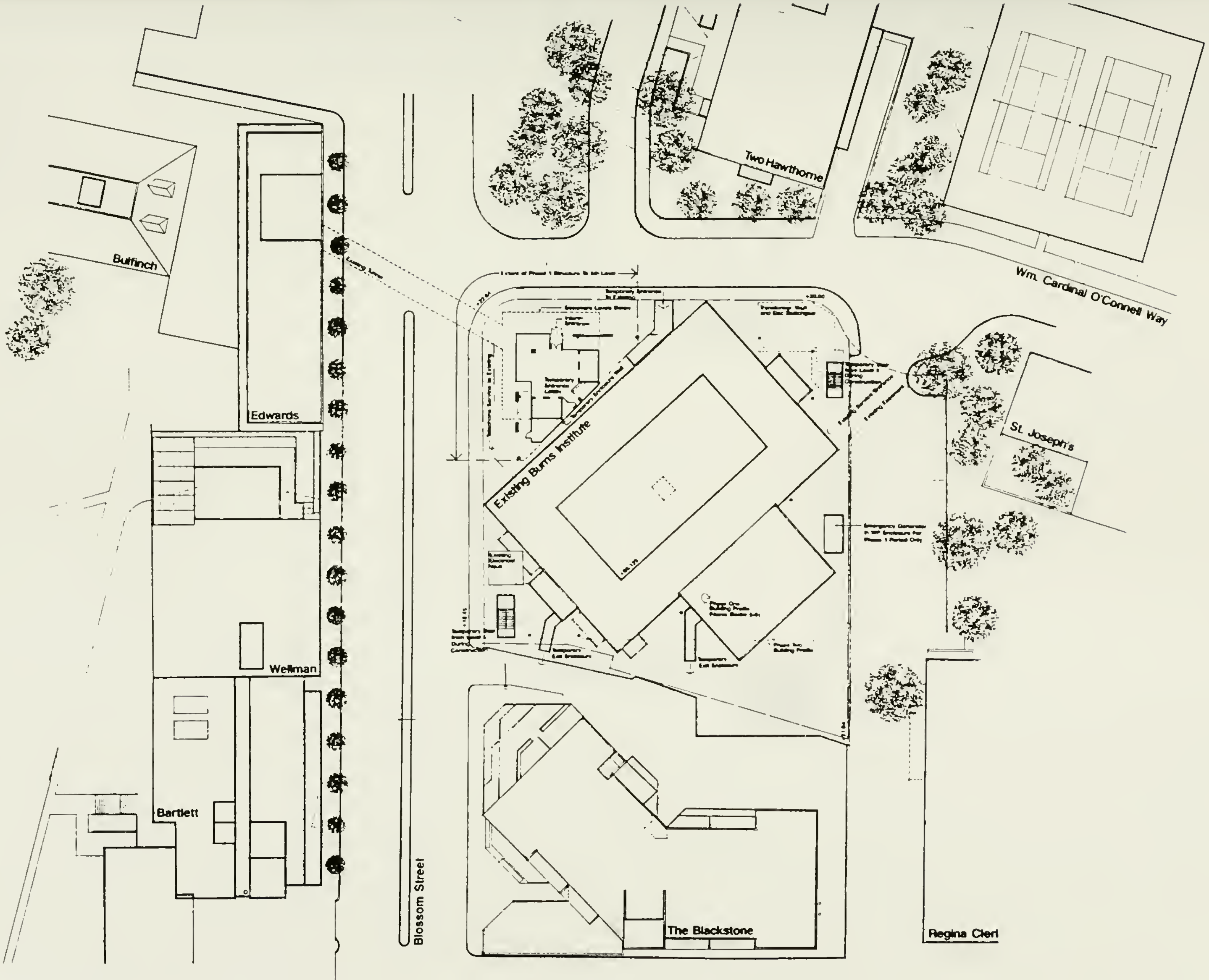
Level 1


Tunnel to MGH
Mechanical
Storage
Elev 1
Elev Pit
Elev Pit
Waterproofing along these Walls (typ)
Edge of Slab at Phase 1
Elect Trans
Elect Trans
Elect Trans
Elect Switchgear
Existing Basement
STORAGE
MAINTENANCE WORKROOM
MAINTENANCE STORAGE
STORAGE
TEL EQUIP
STORAGE
RESEARCH ROOM
CONTROL & DATA ROOM
CENTRAL STORES
OFFICE
OFFICE
MECHANICAL EQUIPMENT ROOM
LECTURE HALL STORAGE
LECTURE HALL LOBBY
MEN
PROF. MEN'S LOCKERS
FEMALE LOCKERS
FEMALE LOUNGE
MALE LOCKERS
WOMEN'S LOUNGE
PROF. WOMEN'S LOCKERS
WOMEN
ELEC. SWITCH GEAR ROOM
EMERGENCY GEN ROOM
PROJ. ROOM
LECTURE HALL LOWER LEVEL
0
16
32

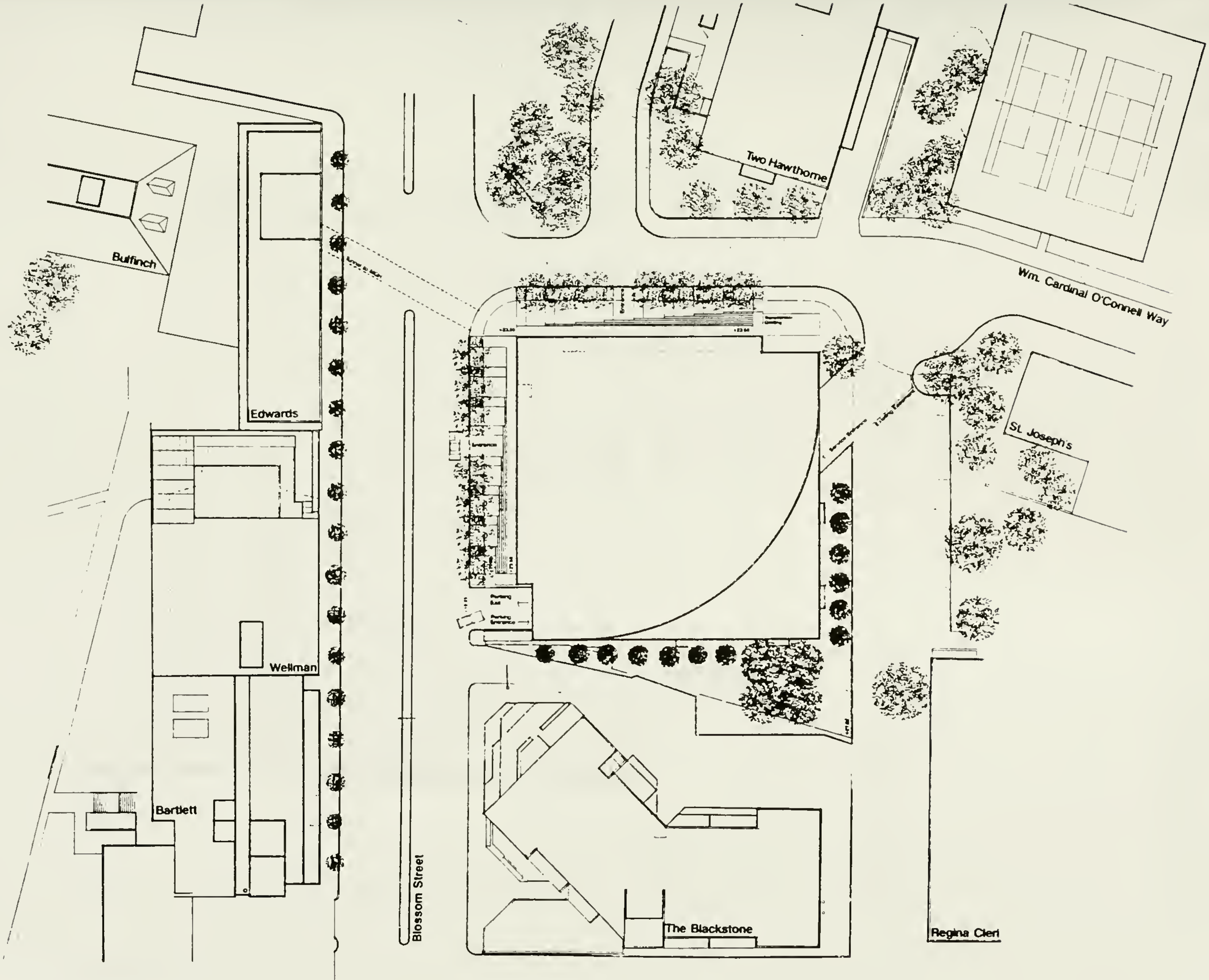
Level P1


Elev
Pit
Parking
Waterproofing along these Walls (typ)
Limit of Existing Foundation
0
16
32

Level P2



Site Plan Phase One



Site Plan Phase Two

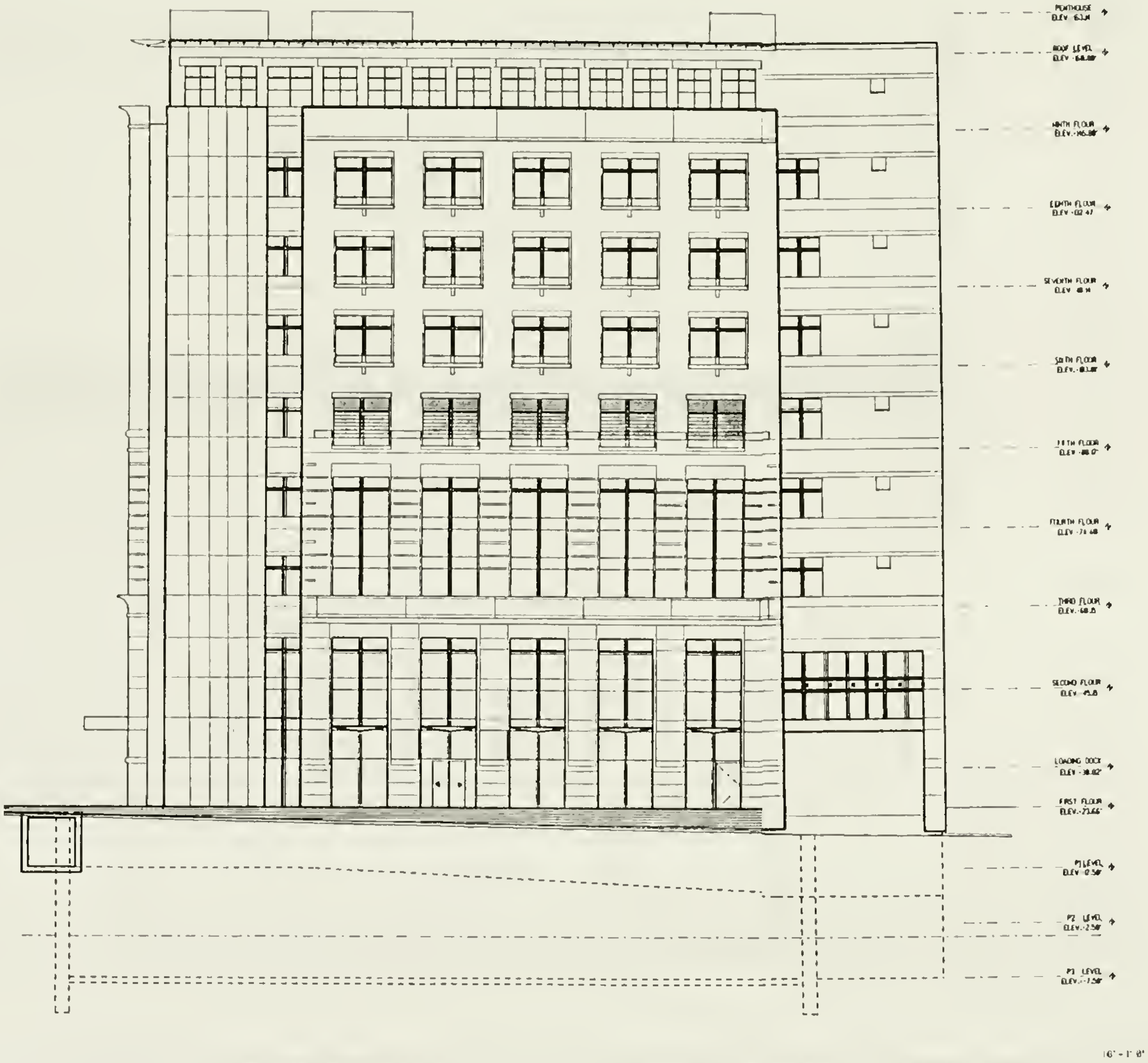
DATE 19-AUG-1992

SHEET NO

SHEET TITLE

PROJECT NAME

PROJECT NO.



PENTHOUSE ELEV. [illegible]
ROOF LEVEL ELEV. [illegible]
NINTH FLOOR ELEV. [illegible]
EIGHTH FLOOR ELEV. ·02 47
SEVENTH FLOOR ELEV. [illegible]
SIXTH FLOOR ELEV. [illegible]
FIFTH FLOOR ELEV. [illegible]
FOURTH FLOOR ELEV. ·71.68
THIRD FLOOR ELEV. ·60.15
SECOND FLOOR ELEV. ·45.8
LOADING DOCK ELEV. ·30.02'
FIRST FLOOR ELEV. ·23.66'
P1 LEVEL ELEV. 0.50'
P2 LEVEL ELEV. -2.50'
P3 LEVEL ELEV. -7.50'

1/8" = 1'-0"

WEST ELEVATION

ODELL

PLANNING · ARCHITECTURE · ENGINEERING

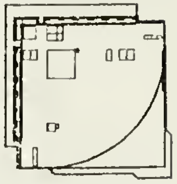
PROGRESS
DRAWING
NOT FOR
CONSTRUCTION

P.I.C. E.ROUK
P.A. D.MURRAY
P.E.
DESIGN J.WALTERS
DRAWN J.MULLEN
ODELL ASSOCIATES INC. CHARLOTTE, N.C.

NO. BY DATE DESCRIPTION

SHRINERS
HOSPITALS
FOR
CRIPPLED
CHILDREN

BURNS INSTITUTE BOSTON UNIT
51 BLOSSOM STREET BOSTON, MA



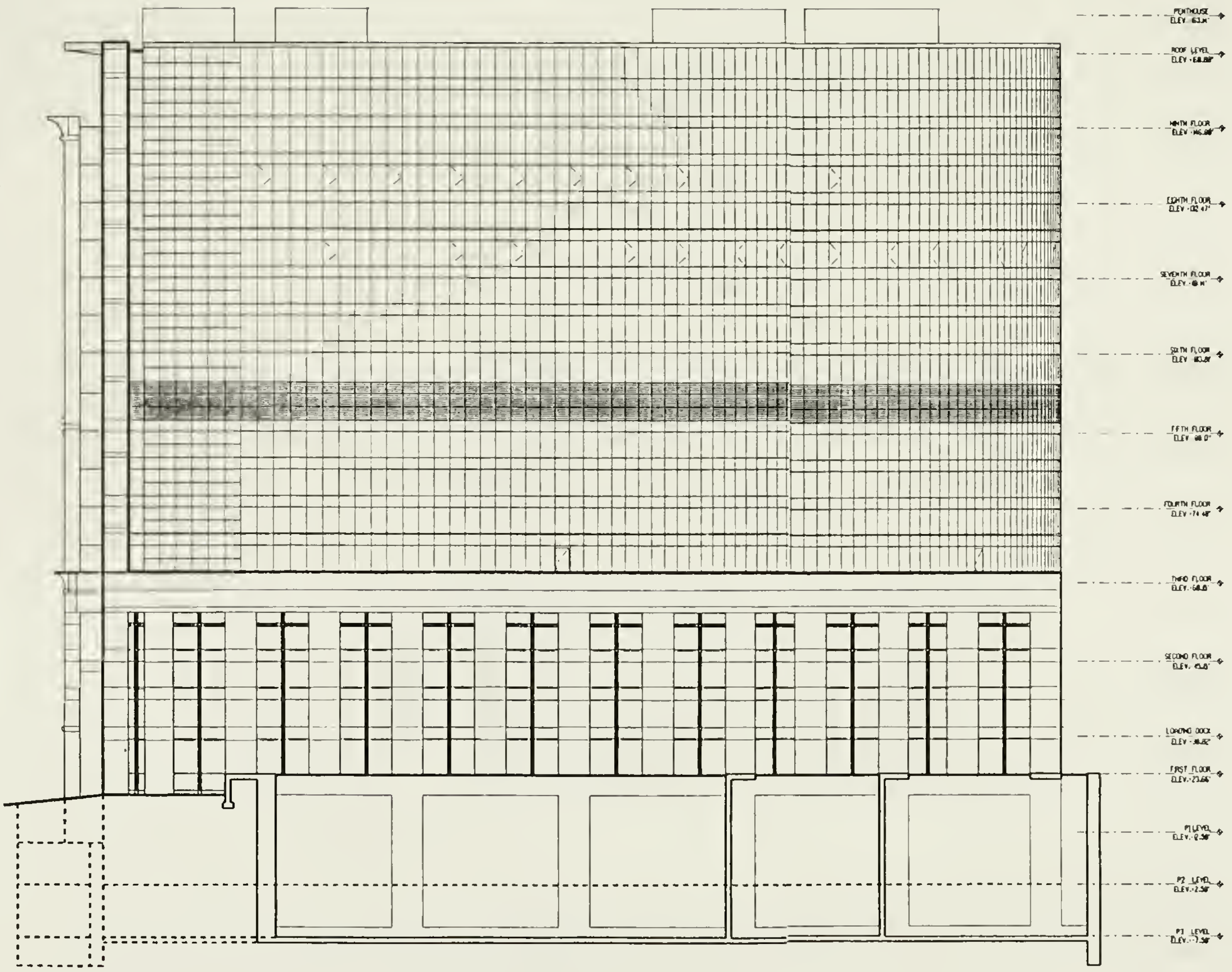
KEY PLAN

SHEET TITLE

WEST ELEVATION

NUMBER

OF



ODELL
PLANNING · ARCHITECTURE · ENGINEERING

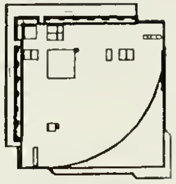
PROGRESS
DRAWING
NOT FOR
CONSTRUCTION

P.I.C. B.ROOK
P.A. D.MURRAY
P.E.
DESIGN J.WALTERS
DRAWN J.MULLEN
ODELL ASSOCIATES INC. CHARLOTTE

NO. BY DATE DESCRIPTION

SHRINERS
HOSPITALS
FOR
CRIPPLED
CHILDREN

BURNS INSTITUTE BOSTON UNIT
51 BLOSSOM STREET BOSTON, MA



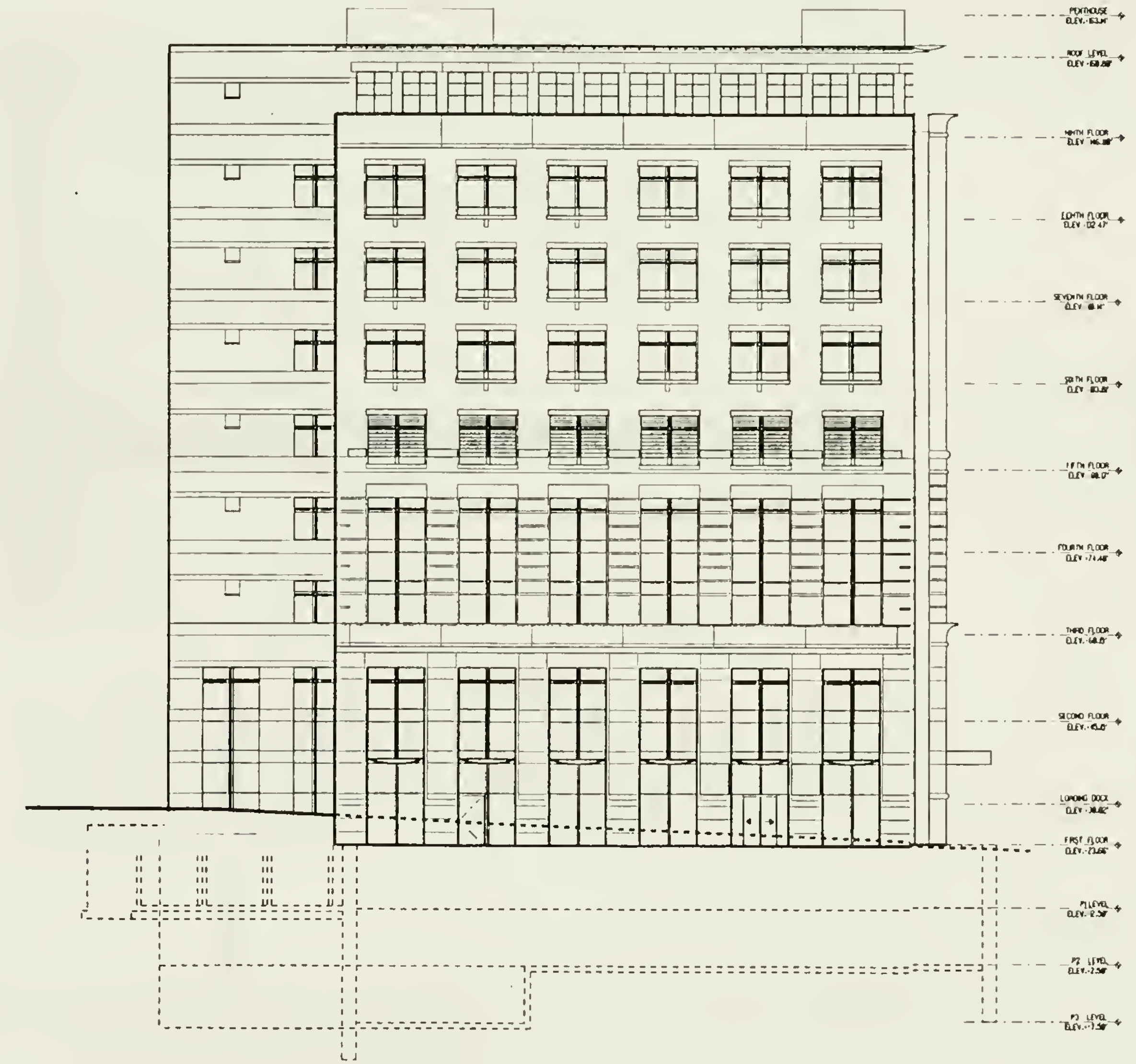
KEY PLAN

SHEET TITLE

SOUTH ELEVATION

PROJECT NUMBER
2331.000
DATE
08.13.82
SHEET NUMBER

A5.2



NORTH ELEVATION

ODELL
PLANNING · ARCHITECTURE · ENGINEERING

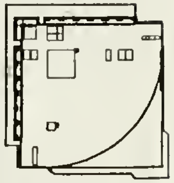
PROGRESS DRAWING NOT FOR CONSTRUCTION

P.I.C. B ROOK
P.A. D.MURRAY
P.E.
DESIGN J WALTERS
DRAWN J MULLEN
ODELL ASSOCIATES INC. CHARLOTTE, NC

NO. BY DATE DESCRIPTION

SHRINERS HOSPITALS FOR CRIPPLED CHILDREN

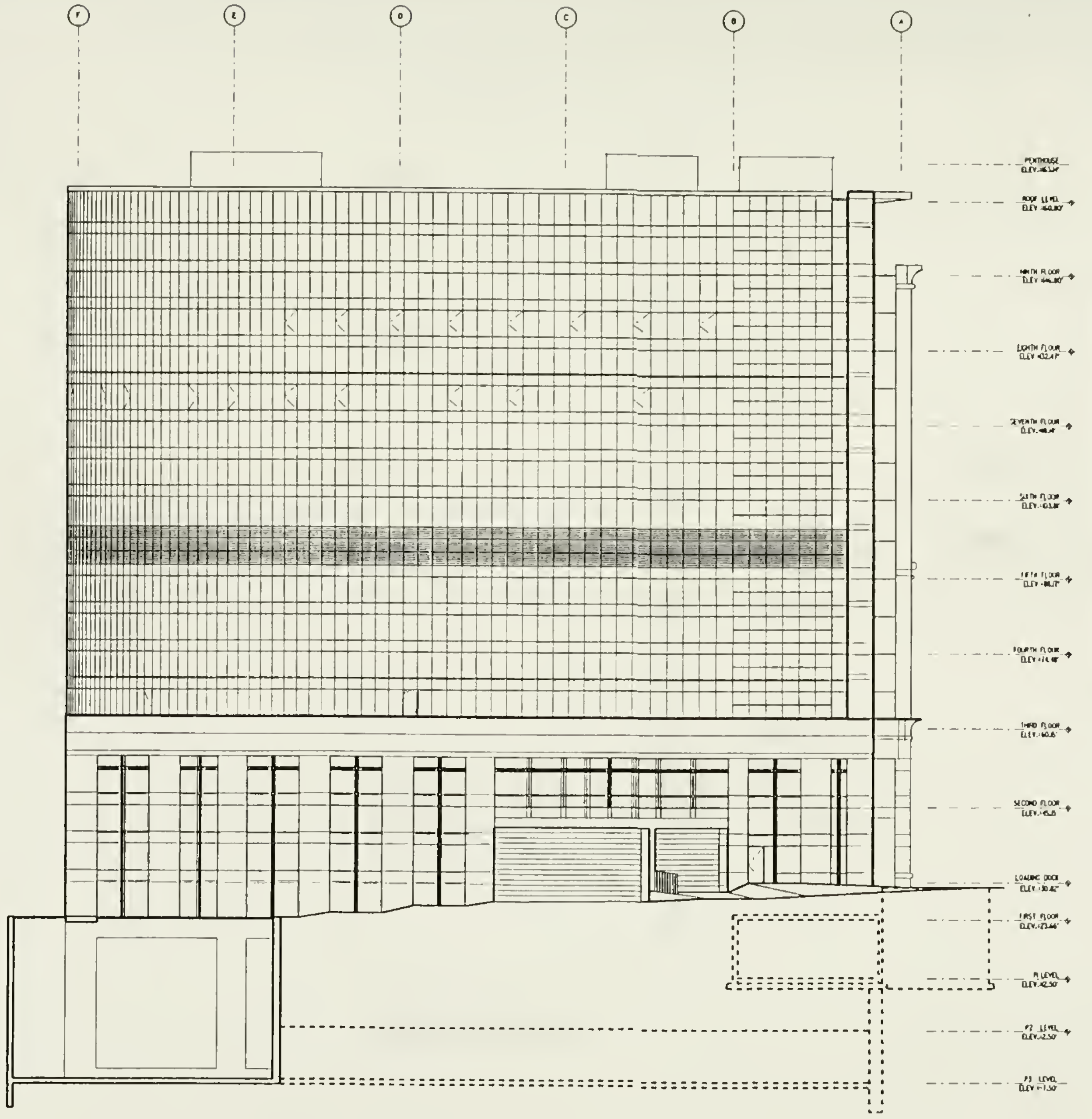
BURNS INSTITUTE BOSTON UNIT
51 BLOSSOM STREET BOSTON, MA



KEY PLAN

SHEET TITLE
NORTH ELEVATION

PROJECT NUMBER
2331.000
DATE
08 13 92
SHEET NUMBER



1 EAST ELEVATION

5 HIDDEN ELEVATION @ LOBBY

ODELL
PLANNING · ARCHITECTURE · ENGINEERING

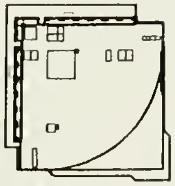
PROGRESS
DRAWING
NOT FOR
CONSTRUCTION

P.I.C. B.ROOK
P.A. D.MURRAY
P.E.
DESIGN J.WALTERS
DRAWN J.MULLEN
ODELL ASSOCIATES INC. CHARLOTTE NC

NO. BY DATE DESCRIPTION

SHRINERS HOSPITALS FOR CRIPPLED CHILDREN

BURNS INSTITUTE BOSTON UNIT
51 BLOSSOM STREET BOSTON, MA

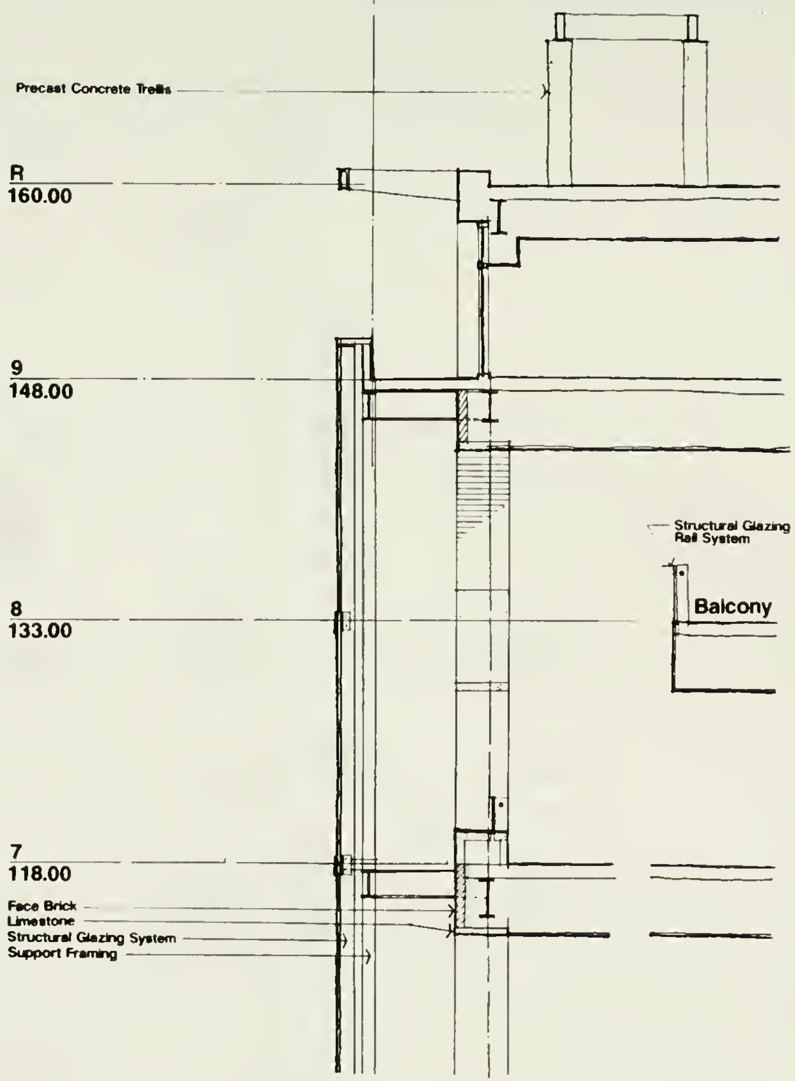


KEY PLAN

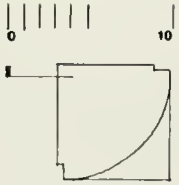
SHEET TITLE

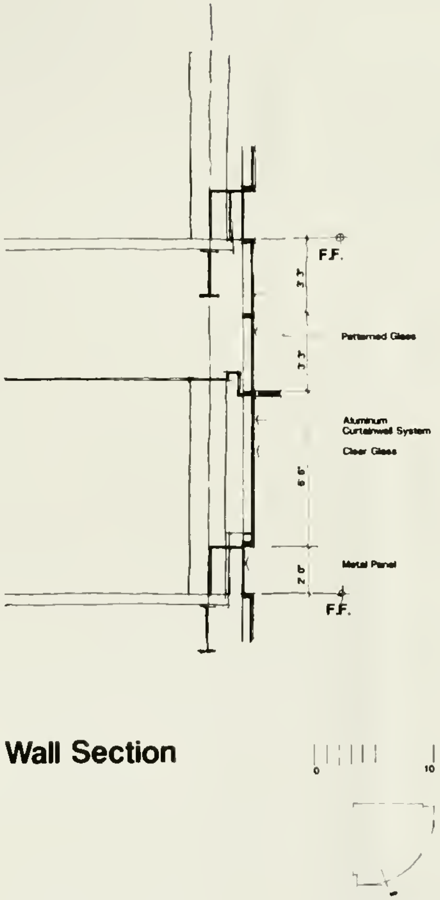
EAST ELEVATION

PROJECT NUMBER
2331 000
DATE
08 13 92
SHEET NUMBER

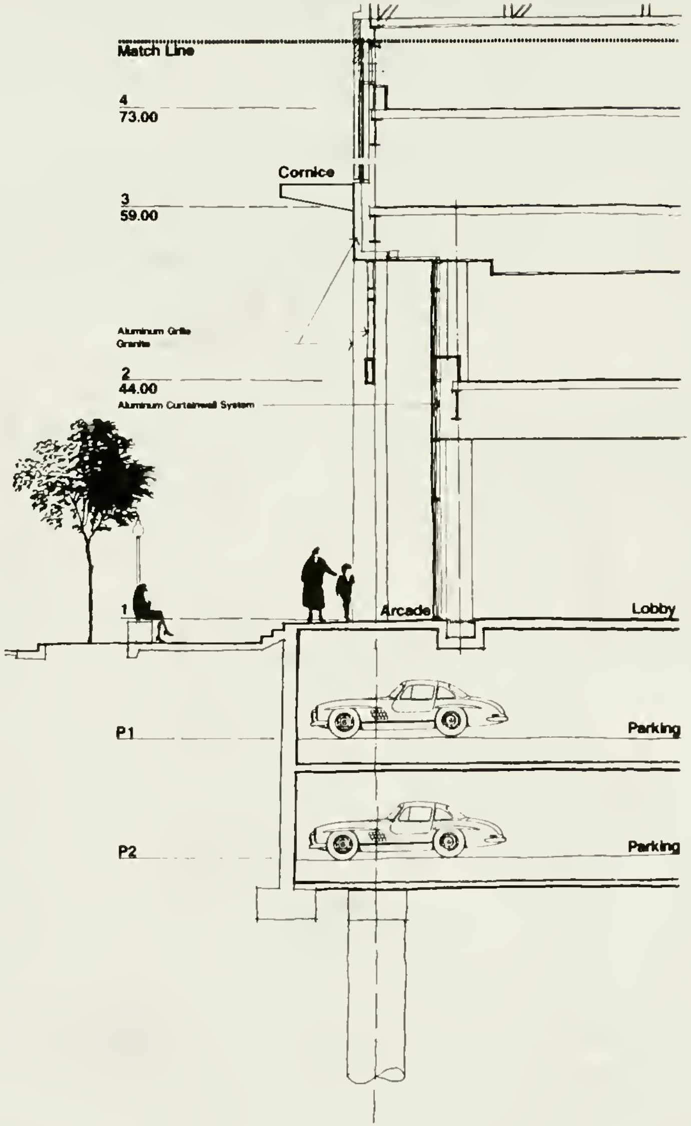


Wall Section

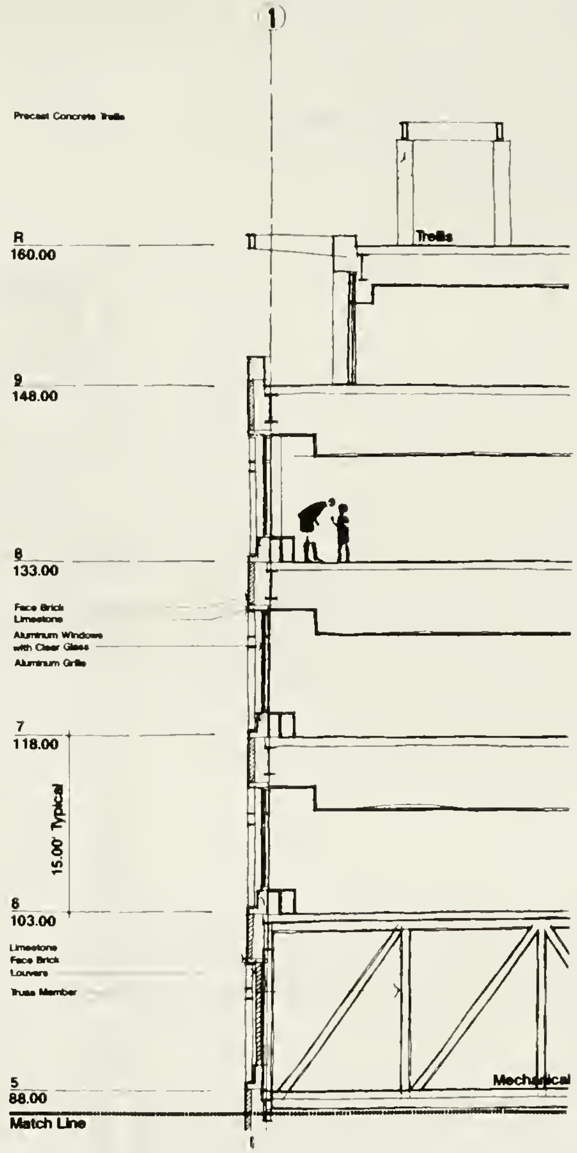




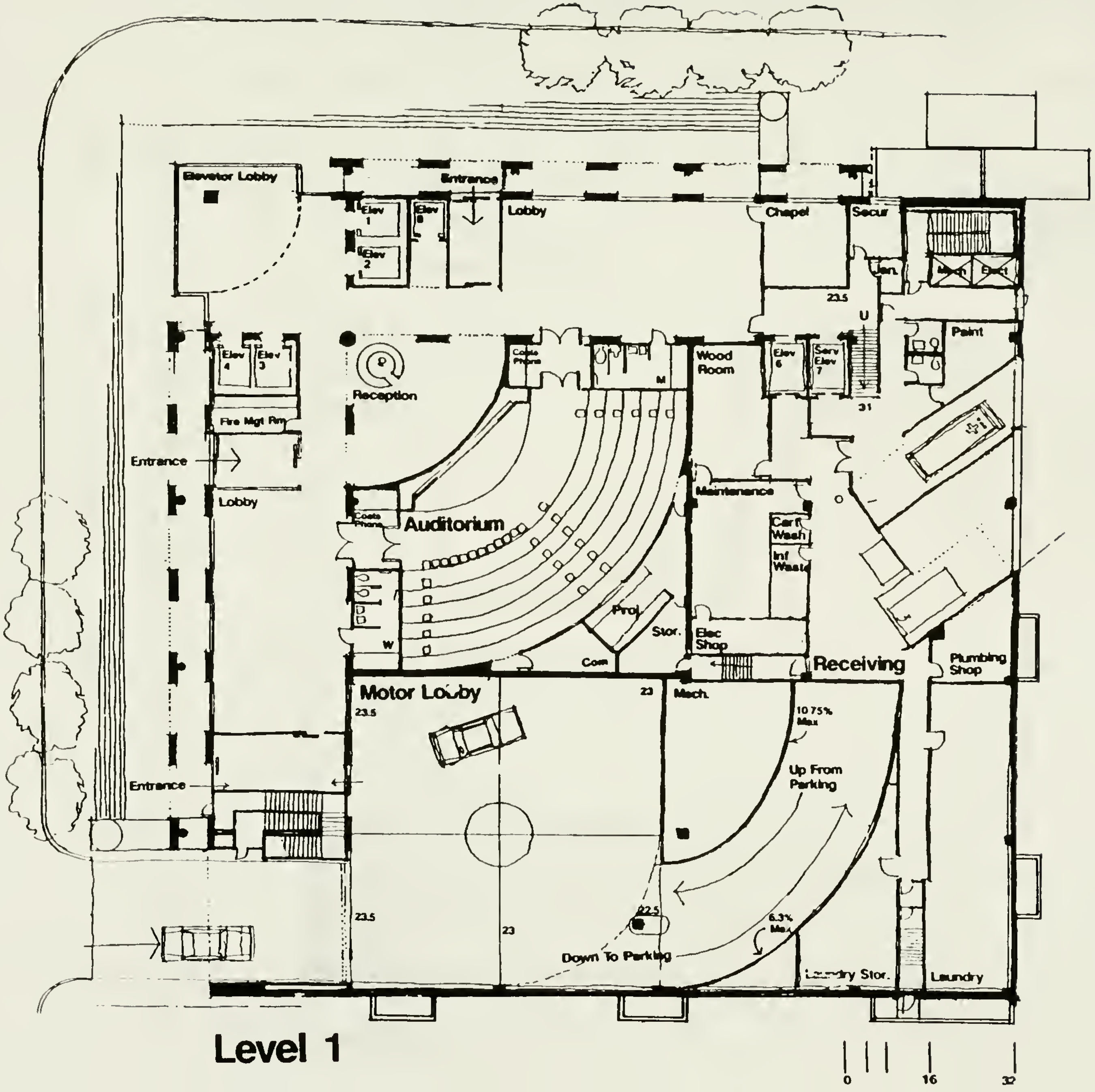
Wall Section



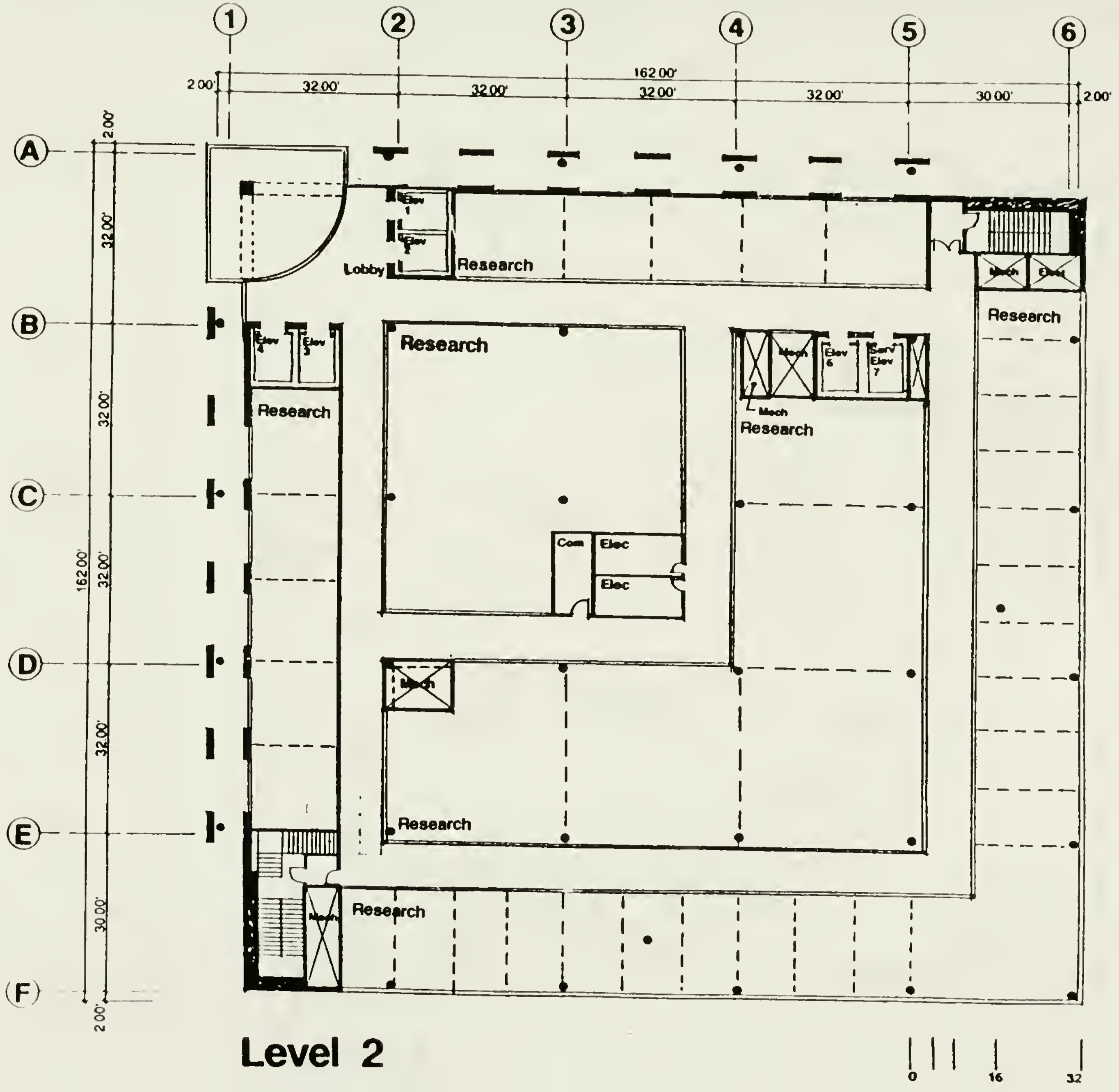
Wall Section



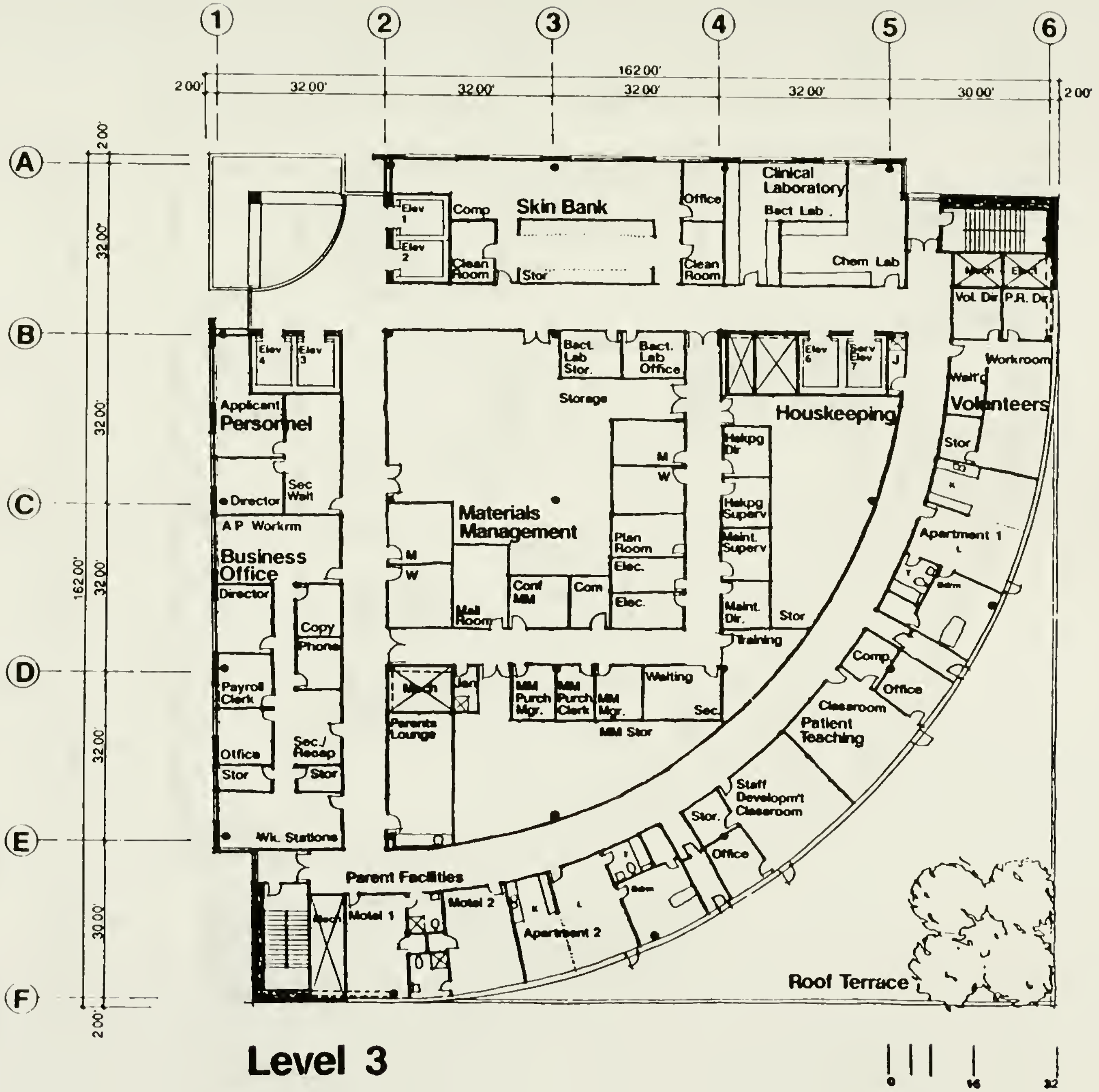
Wall Section


Elevator Lobby
Entrance
Lobby
Elev 1
Elev 2
Elev 8
Chapel
Secur
Jan.
Mech.
Elect
23.5
U
31
Paint
Elev 4
Elev 3
Reception
Coats Phone
M
Wood Room
Elev 6
Serv Elev 7
Fire Mgt Rm
Entrance
Lobby
Auditorium
Maintenance
Cart Wash
Inf Waste
Coats Phone
W
Proj
Stor.
Com
Elec Shop
Receiving
Plumbing Shop
Motor Lobby
23.5
23
Mech.
10.75% Max
Up From Parking
Entrance
23.5
23
22.5
6.3% Max
Down To Parking
Laundry Stor.
Laundry
0
16
32

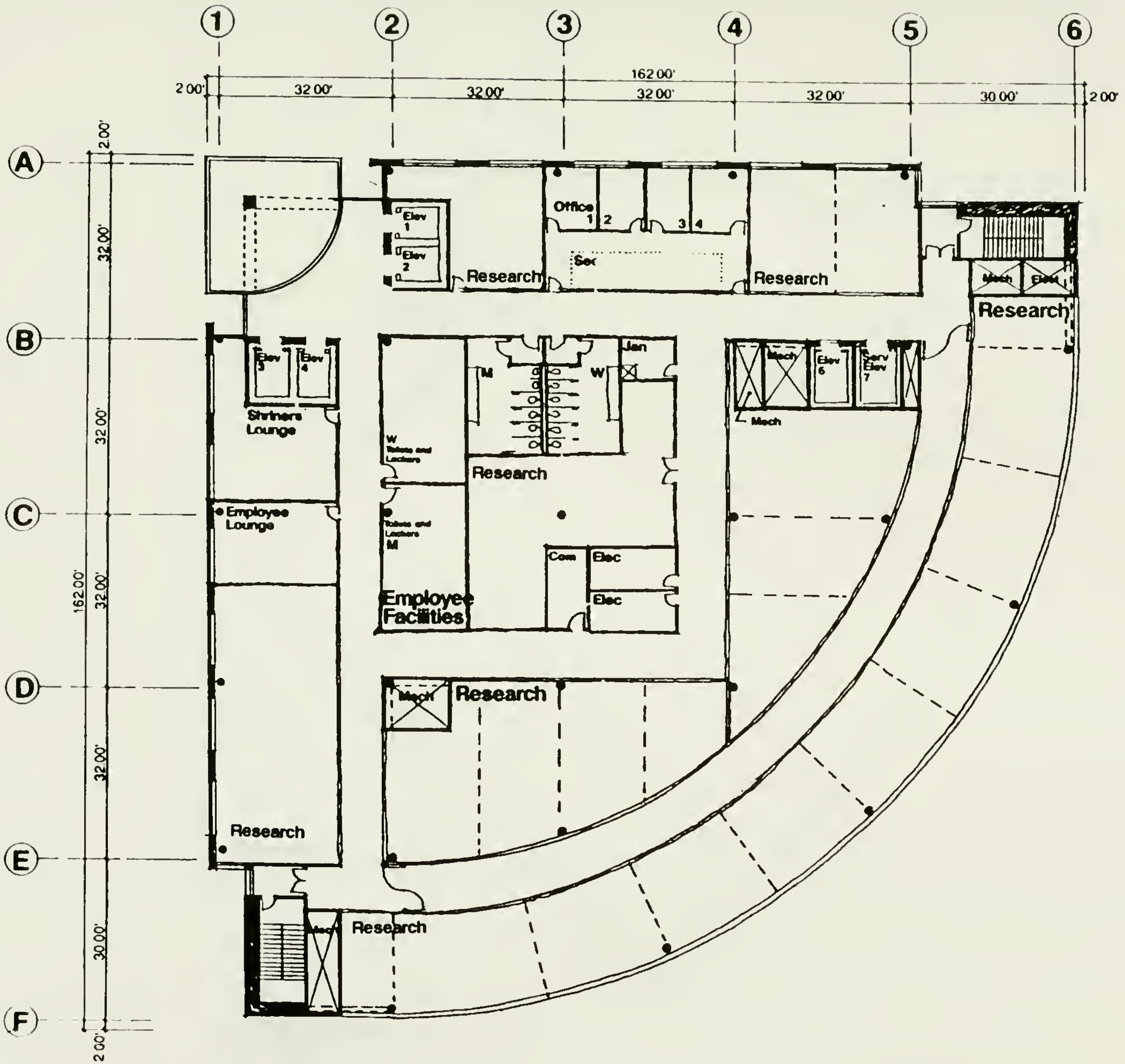
Level 1


1
2
3
4
5
6
162.00'
2.00'
32.00'
32.00'
32.00'
32.00'
30.00'
2.00'
A
B
C
D
E
F
162.00'
Lobby
Elev 1
Elev 2
Research
Mech
Elec
Research
Elev 4
Elev 3
Research
Research
Com
Elec
Elec
Mech
Elev 6
Serv Elev 7
Mech
Research
Mech
Research
Mech
Research
0
16
32

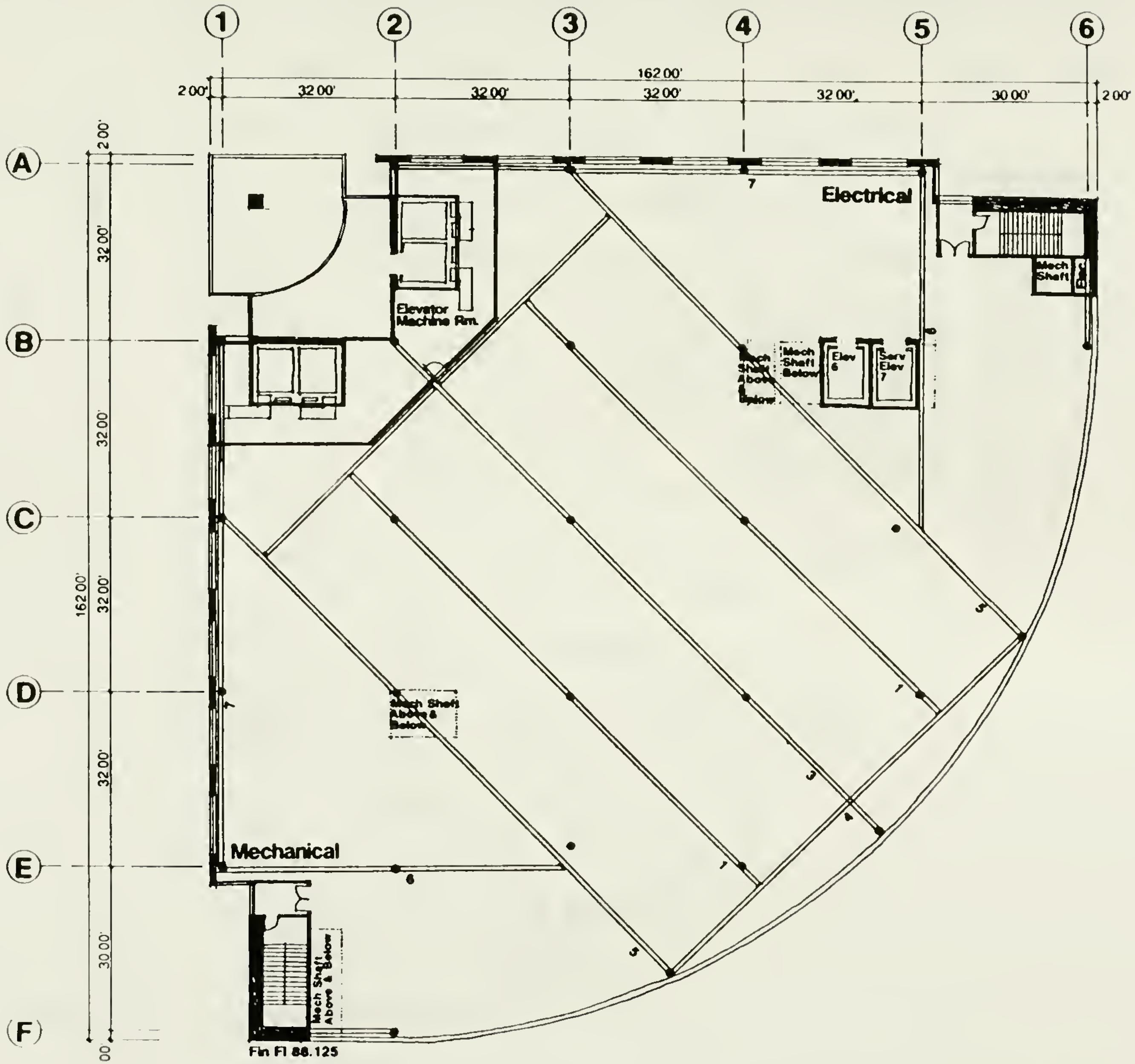
Level 2


1
2
3
4
5
6
162 00'
2 00'
32 00'
32 00'
32 00'
32 00'
30 00'
2 00'
A
B
C
D
E
F
Skin Bank
Elev 1
Elev 2
Comp
Clean Room
Stor
Office
Clean Room
Clinical Laboratory
Bact Lab
Chem Lab
Mech
Elev
Vol. Dir
P.R. Dir
Workroom
Wait'g
Volunteers
Stor
Apartment 1
Bdrm
Comp.
Office
Classroom
Patient Teaching
Staff Developm't Classroom
Stor.
Office
Bdrm
Apartment 2
Motel 2
Motel 1
Mech
Parent Facilities
Roof Terrace
Elev 4
Elev 3
Applicant
Personnel
Director
Sec Wait
A P Workrm
Business Office
Director
Copy
Phone
Payroll Clerk
Office
Stor
Sec./Recep
Stor
Wk. Stations
Bact. Lab Stor.
Bact. Lab Office
Storage
Elev 6
Serv Elev 7
J
Houskeeping
Hskpg Dir
Hskpg Superv
Maint. Superv
Maint. Dir.
Stor
Training
M
W
Materials Management
M
W
Plan Room
Elec.
Elec.
Conf MM
Com
Mail Room
Mech
Jan
Parents Lounge
MM Purch Mgr.
MM Purch Clerk
MM Mgr.
Waiting
Sec
MM Stor
0
16
32

Level 3


1
2
3
4
5
6
162 00'
2 00'
32 00'
32 00'
32 00'
32 00'
30 00'
2 00'
A
B
C
D
E
F
2 00'
32 00'
32 00'
162 00'
32 00'
32 00'
30 00'
2 00'
Elev 1
Elev 2
Research
Office 1
2
3
4
Sec
Research
Mech
Elev
Research
Elev 3
Elev 4
Shriners Lounge
Employee Lounge
Research
W Toilets and Lockers
Toilets and Lockers M
Employee Facilities
M
W
Jan
Research
Com
Elec
Elec
Mech
Elev 6
Serv Elev 7
Mech
Mech
Research
Mech
Research
0
16
32

Level 4



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Electrical
Elevator Machine Rm.
Mech Shaft
Mech Shaft Below
Elev 6
Serv Elev 7
Mech Shaft Above & Below
Mech Shaft Above & Below
Mechanical
Mech Shaft Above & Below
Fin Fl 88.125
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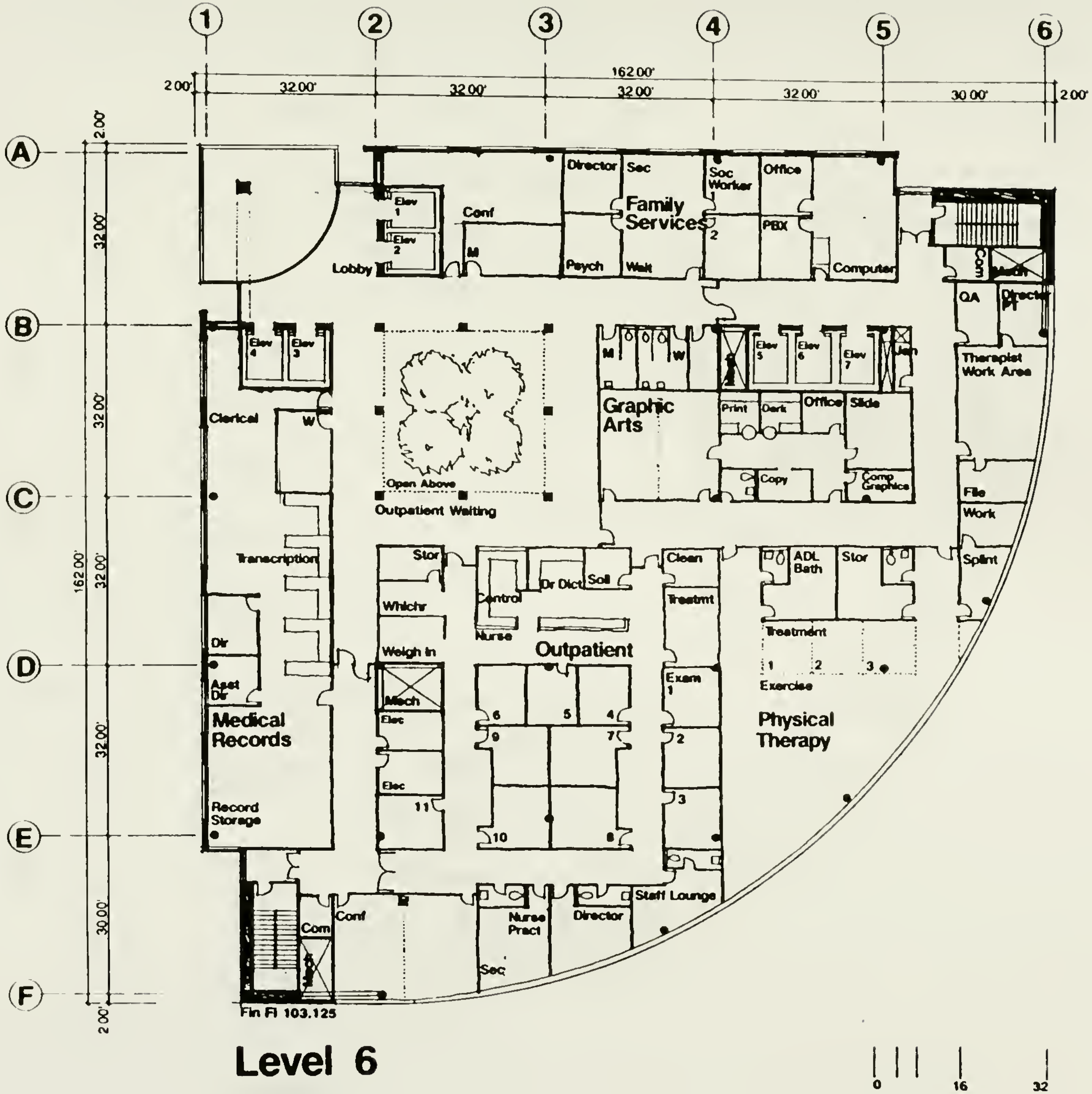
16
32

Level 5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Lobby
Elev 1
Elev 2
Elev 3
Elev 4
Elev 5
Elev 6
Elev 7
Conf
M
W
Director
Sec
Family Services
Psych
Wait
Soc Worker
Office
PBX
Computer
Com
Mech
QA
Director PT
Therapist Work Area
File
Work
Splint
Jan
Graphic Arts
Print
Dark
Office
Slide
Copy
Comp Graphics
Open Above
Outpatient Waiting
Clerical
Transcription
Dir
Asst Dir
Medical Records
Record Storage
Stor
Whlchr
Weigh In
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Control
Nurse
Dr Dict
Soil
Outpatient
Clean
Treatmt
Exam 1
ADL Bath
Treatment
Exercise
Physical Therapy
Staff Lounge
Nurse Pract
Sec
Fin Fl 103.125
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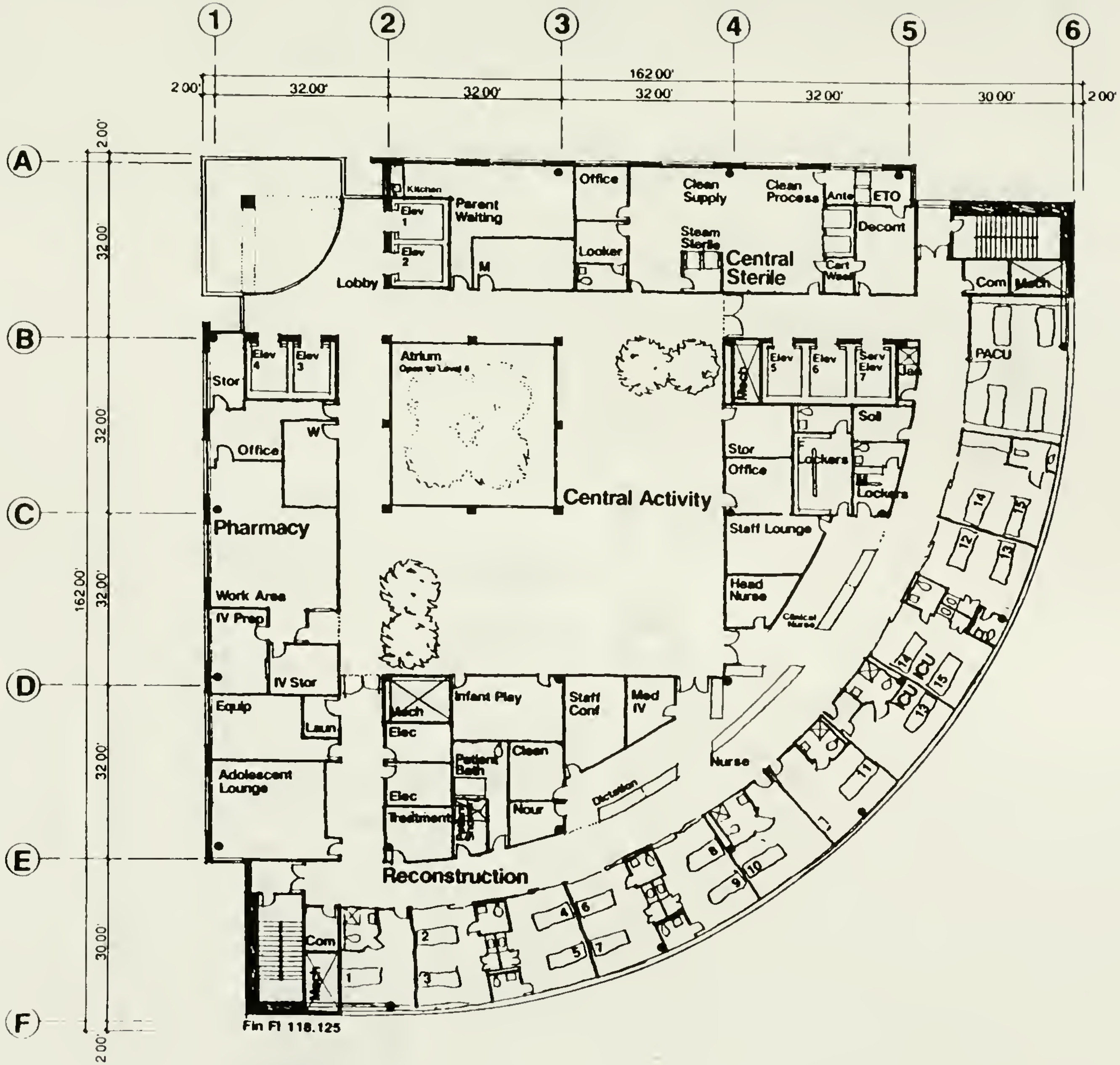
Level 6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30 00'
2 00'
Kitchen
Parent Waiting
Elev 1
Elev 2
Lobby
M
Office
Locker
Clean Supply
Steam Sterile
Central Sterile
Clean Process
Ante
ETO
Decont
Cart Wash
Com
Mech
PACU
Stor
Elev 4
Elev 3
W
Office
Pharmacy
Work Area
IV Prep
IV Stor
Equip
Laun
Adolescent Lounge
Atrium
Open to Level 6
Central Activity
Elev 5
Elev 6
Serv Elev 7
Jan
Mech
Soil
Stor
Office
Lockers
Lockers
Staff Lounge
Head Nurse
Clinical Nurse
14
15
12
13
ICU
ICU
14
15
13
11
Mech
Infant Play
Staff Conf
Med IV
Elec
Patient Bath
Clean
Elec
Treatment
Nour
Dictation
Nurse
Reconstruction
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9
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3
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Com
Mech
Fin Fl 118.125
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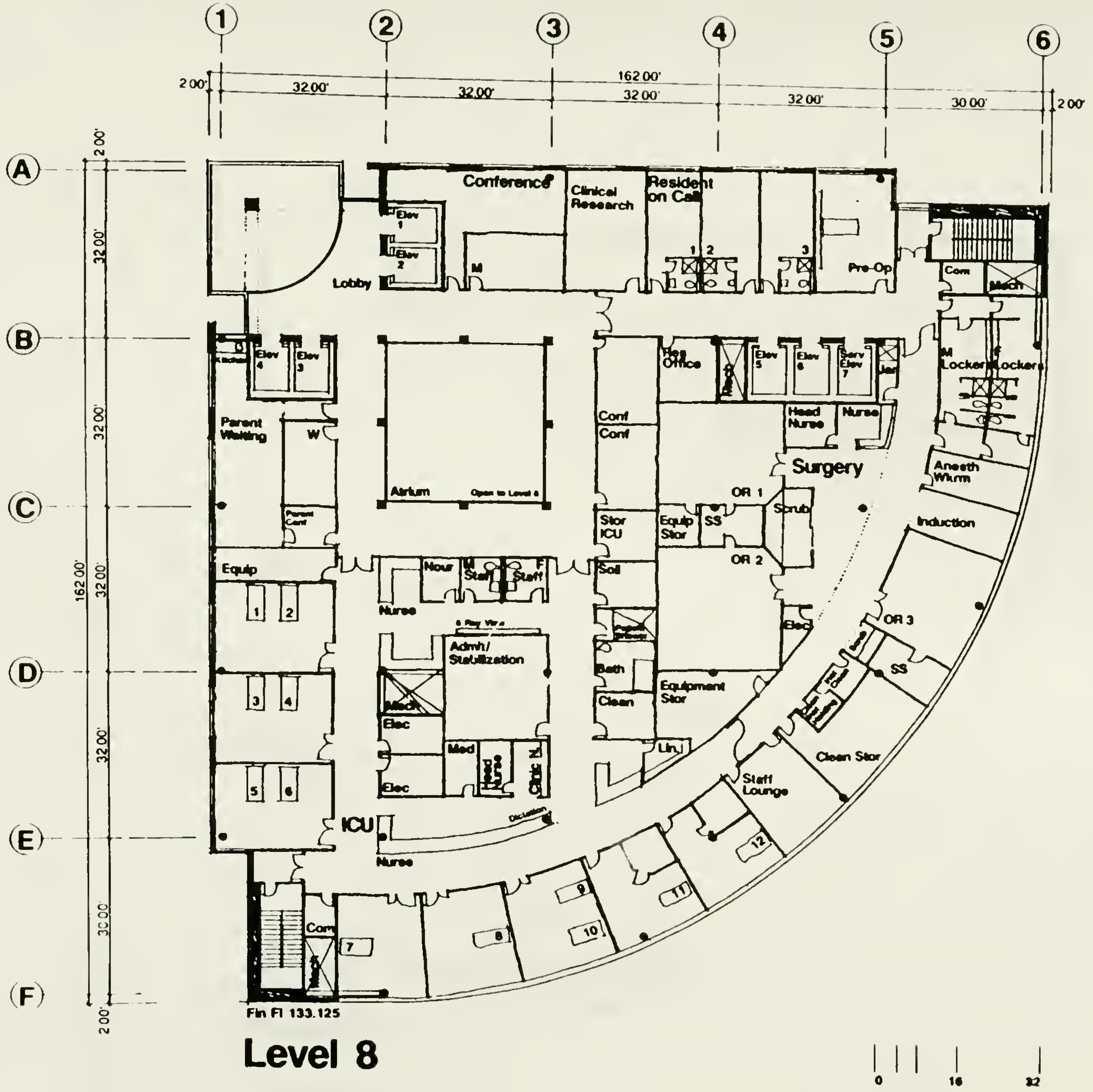
16
32

Level 7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A
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F
162.00'
Conference
Clinical Research
Resident on Call
Pre-Op
Lobby
Elev 1
Elev 2
Elev 3
Elev 4
Elev 5
Elev 6
Serv Elev 7
M
Com
Mech
Hsg Office
Jan
M Lockers
F Lockers
Parent Waiting
W
Parent Conf
Atrium
Open to Level 6
Conf
Conf
Head Nurse
Nurse
Surgery
OR 1
OR 2
OR 3
Scrub
SS
Equip Stor
Stor ICU
Soil
Aneath Wkrm
Induction
Equip
Nour
M Staff
F Staff
Nurse
Admit/ Stabilization
Mech
Elec
Elec
Med
Bath
Clean
Equipment Stor
Lin
Clean Stor
Staff Lounge
ICU
Nurse
Dictation
Com
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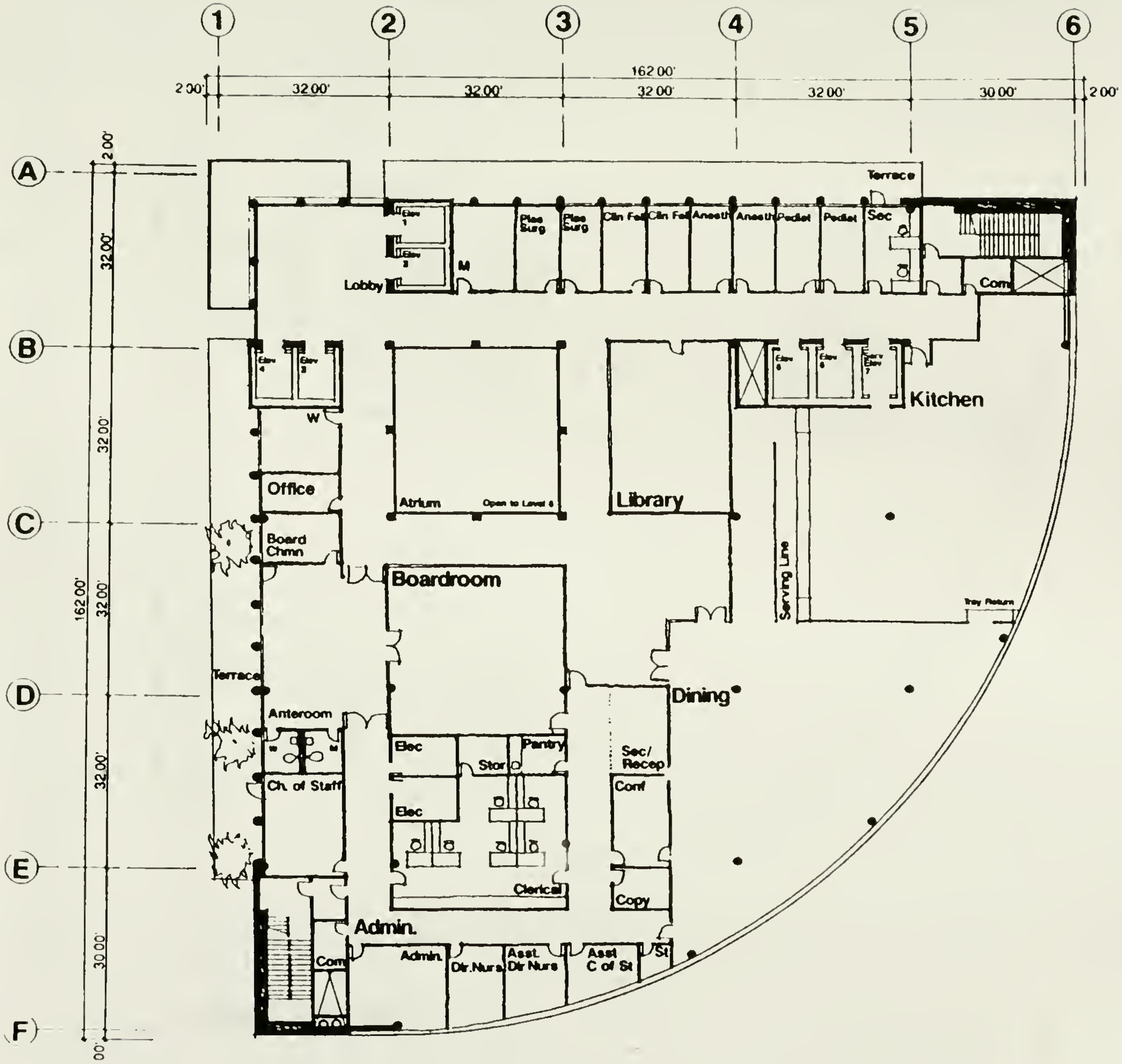
11
12
Fin Fl 133.125
0
16
32

Level 8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32.00'
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32.00'
32.00'
30.00'
2.00'
A
B
C
D
E
F
Terrace
Elev 1
Elev 2
Lobby
M
Plas Surg
Plas Surg
Clin Fel
Clin Fel
Anesth
Anesth
Pediat
Pediat
Sec
Com
Elev 4
Elev 3
W
Office
Board Chmn
Atrium
Open to Level 8
Library
Elev 5
Elev 6
Serv Elev 7
Kitchen
Serving Line
Tray Return
Boardroom
Terrace
Dining
Anteroom
Elec
Stor
Pantry
Sec/ Recep
Ch. of Staff
Elec
Conf
Clerical
Copy
Admin.
Com
Admin.
Dir. Nurs
Asst. Dir Nurs
Asst C of St
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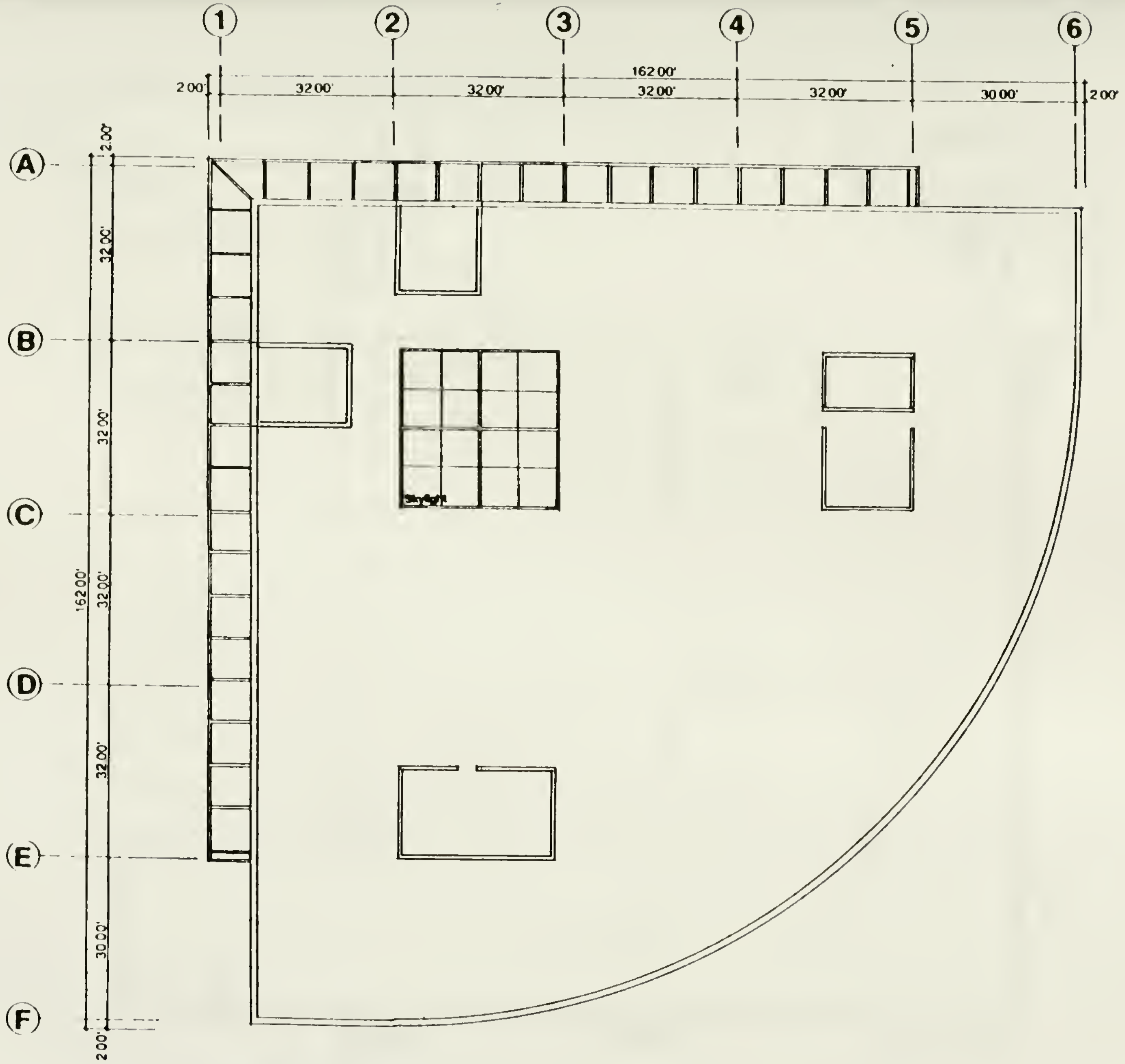
Level 9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2.00'
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32.00'
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2.00'
162.00'
Skylight
0
16
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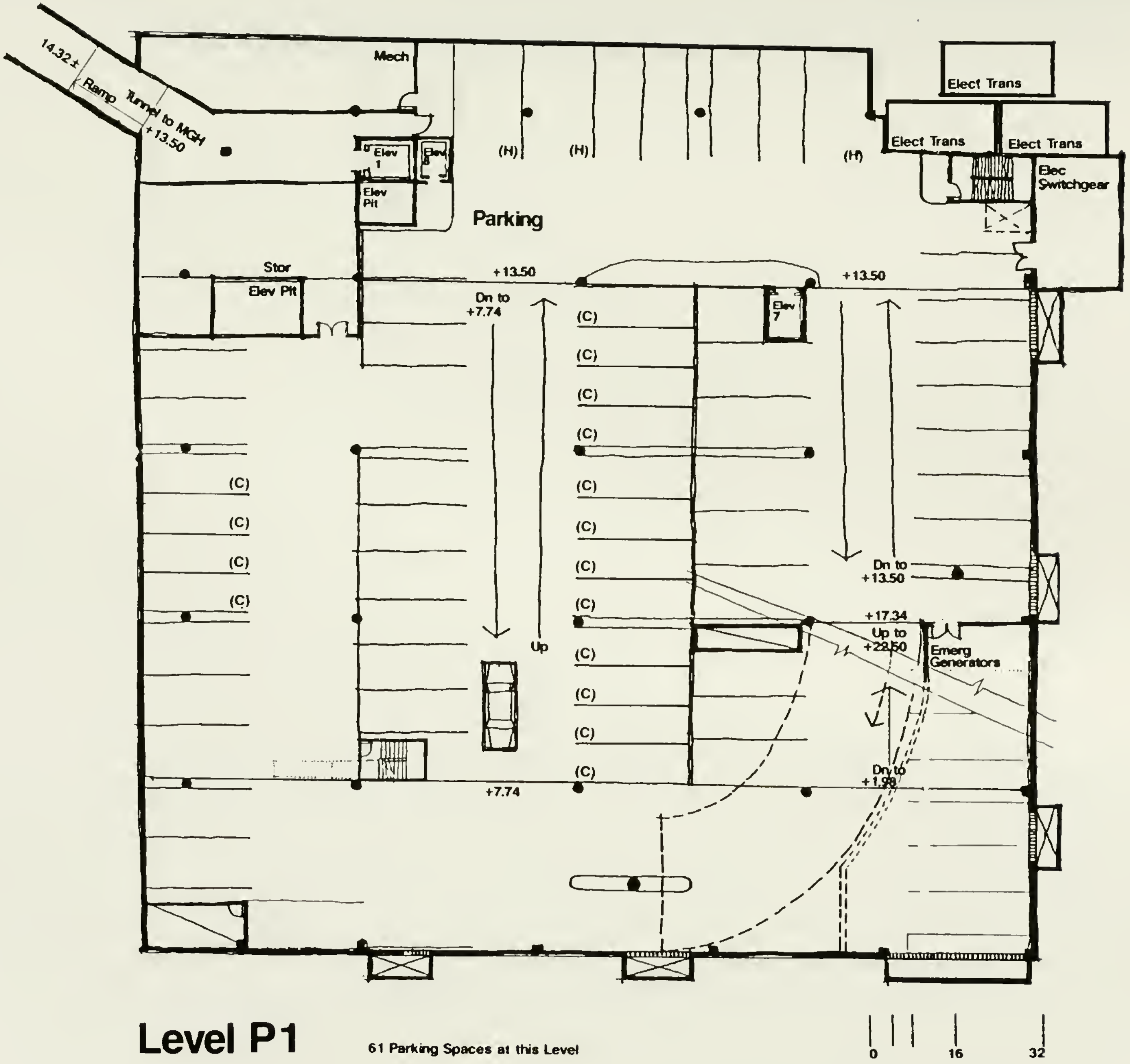
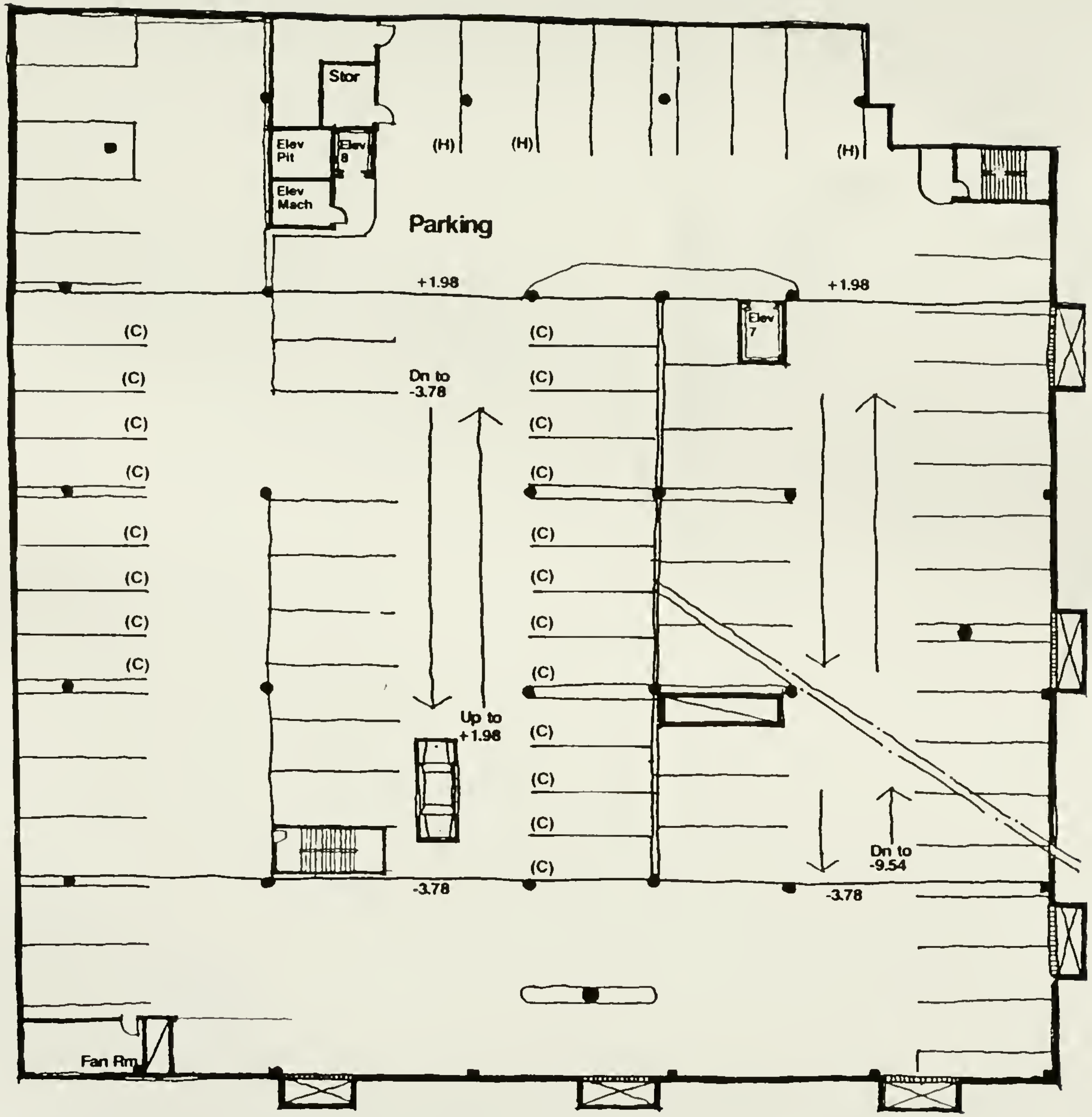
Roof Level



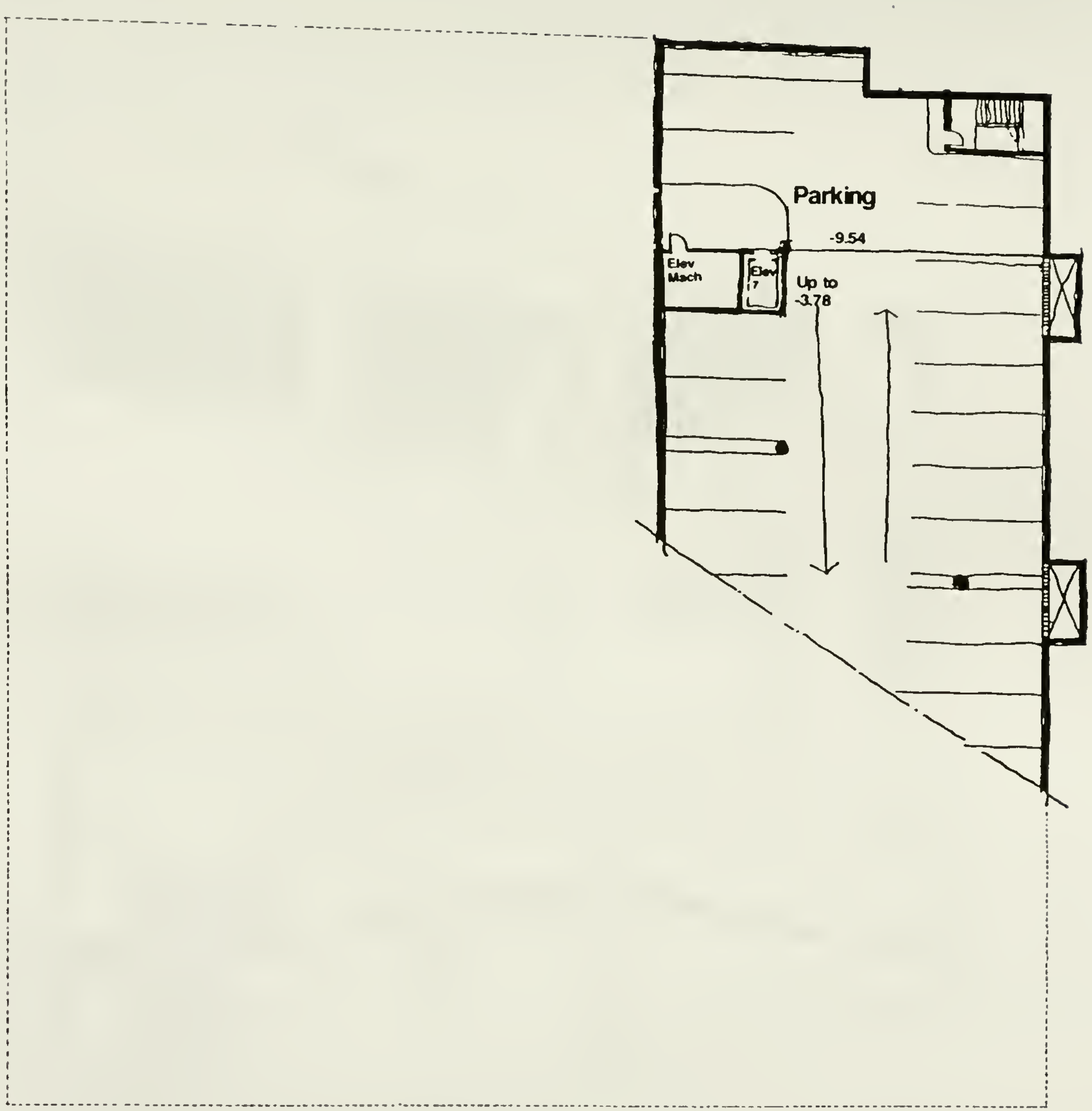
Level P1

61 Parking Spaces at this Level



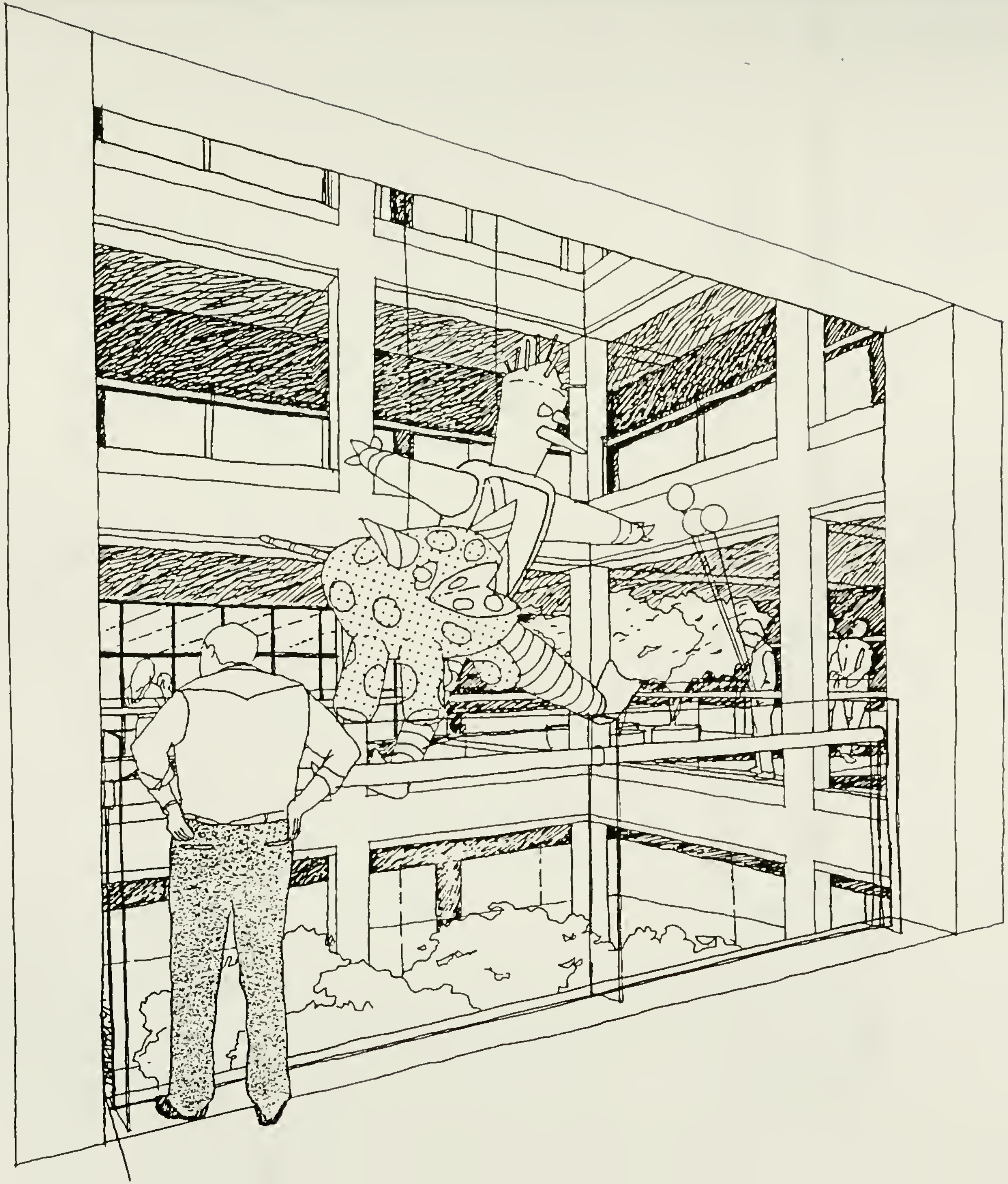
Level P2

71 Parking Spaces at this Level



Level P3

17 Parking Spaces at this Level



Appendix F

Map Amendment No. 281
"U" Designation for Shriners Burns Institute Site

Map Amendment Application No. 341
Boston Redevelopment Authority in
behalf of the Shriners Hospitals for
Crippled Children
West End: Blossom Street
"U" designation for Burns Institute
site

MAP AMENDMENT NO. 281

THE COMMONWEALTH OF MASSACHUSETTS

EFFECTIVE
June 12, 1992*

CITY OF BOSTON

IN ZONING COMMISSION

The Zoning Commission of the City of Boston, acting under Chapter 665 of the Acts of 1956 as amended, after due report, notice, and hearing does hereby amend "Map 1 Boston Proper," of the series of maps entitled "Zoning Districts City of Boston," dated August 15, 1962, as follows:

> By granting the designation "U", indicating an Urban Renewal Area overlay district, to the existing H-3 designation of a parcel of land in the West End district of Boston Proper, which parcel is bounded generally by Blossom Street to the west, William Cardinal O'Connell Way to the north, St. Joseph's Church and the Regina Cleri House to the east, and the Blackstone Apartments to the south, and is more particularly described in Exhibit A attached.
>
> Said land, which is in Subdistrict M of the Downtown Interim Planning Overlay District (IPOD) for the remaining period said IPOD is in effect, constitutes Parcel 8 of the West End Land Assembly and Redevelopment Project Area.

---

*Date of public notice: April 13, 1992 (see St. 1956, c. 665, s. 5).

NPZ6/11.MAA
061292

EXHIBIT A

PROJECT SITE

A certain parcel of land situated in Boston, Suffolk County in the Commonwealth of Massachusetts, bounded and described as follows:

Beginning at a drill hole on the southerly side of William Cardinal O’Connell Way, said point being the most northwest corner of Parcel 7 as shown on a plan entitled "Plan of Land in Boston, dated April 13, 1962, Parcel 7 of West End Land Assembly and Redevelopment Plan, Prepared by J.L. Hayden Associates, Inc.", which is recorded with Suffolk Registry of Deeds in Book 7679, Page 307; thence

S 01° 27’ 43" E	a distance of two hundred twelve and forty-seven hundredths feet (212.47) to a stake; thence
N 75° 21’ 38" W	a distance of twenty-two and eighty-three hundredths feet (22.83) to a stake; thence
N 75° 19’ 30" W	a distance of one hundred ten and seventy-four hundredths feet (110.74) to a mark on a concrete wall; thence
N 14° 19’34" E	a distance of seven and thirty-nine hundredths feet (7.39) to a stake; thence
N 75° 35’ 17" W	a distance of three and fifty-five hundredths feet (3.55) to a stake; thence
N 76° 52’ 03" W	a distance of twenty-three and twenty-two hundredths feet (23.22) to a drill hole; thence
S 35° 06’ 09" E	a distance of zero and twenty-five hundredths feet (0.25) to a drill hole; thence
S 88° 56’ 32" W	a distance of forty-four and thirty-three feet (44.33) to a drill hole, the previous seven courses bounding on land now or formerly of the Blackstone Company; thence
N 01° 27’ 43" W	a distance of one hundred sixty-two and twenty-one hundredths feet (162.21) along the easterly side line of Blossom Street to a drill hole; thence
Northeasterly	and curving to the right along the arc of a curve having a radius of twenty and no hundredths feet (20.00) a length of thirty-one and forty-two hundredths feet (31.42) to a drill hole; thence

N 88° 32" 17" E	a distance of one hundred fifty-three and ninety-two hundredths feet (153.92) along the southerly sideline of William Cardinal O'Connell Way to a drill hole; thence
Southeasterly	and curving to the right along the arc of a curve having a radius of twenty and no hundredths feet (20.00) a length of twenty-four and sixty-two feet (24.62) to a re-bar; thence
Southeasterly	and curving to the left along the arc of a curve having a radius of forty and no hundredths feet (40.00) a length of eight and thirty-nine hundredths feet (8.39) to a drill hole and the point of beginning.

The above described parcel of land contains thirty-nine thousand and eight hundred and twenty-five square feet (39,825) more or less, and is more particularly shown on plan prepared by Cullinan Engineering Co., Inc. entitled, "Topographic Plan of Land, Shriners Burns Institute, 51 Blossom Street, Boston, Massachusetts" dated June 28, 1991.

This same parcel is shown on a plan entitled "Plan of Land in Boston, dated September 10, 1963, Parcel 8 of West End Land Assembly and Redevelopment Plan, prepared by J.L. Hayden Associates, Inc." which plan is recorded with the Suffolk Registry of Deeds in Book 7916, Page 518.

A portion of this property is registered land described in Cert. No. 73490, Parcels 2 and 3 on LC Decree Plan 892B.

The described parcel is subject to conditions duly recorded in the following Suffolk Registry of Deeds Volumes:

1) Book 7916, Page 518, Document No. 270117;
2) Book 7916, Page 524, Document No. 270116;
3) Book 7464, Page 321;
4) An easement of the City of Boston, Book 7951, Page 302.

Map Amendment Application No. 341 Map Amendment No. 281

Richard B. [illegible]
Chairman

Robert L. Mon
Vice Chairman

[illegible]

Jean M. McGrath

Robert Fowler

Edward J. D'Agostino

Edwards J. [illegible] Jr.

In Zoning Commission

Adopted June 11, 1992

Attest: Marguerite Hildebrand
Secretary

Map Amendment Application No. 341

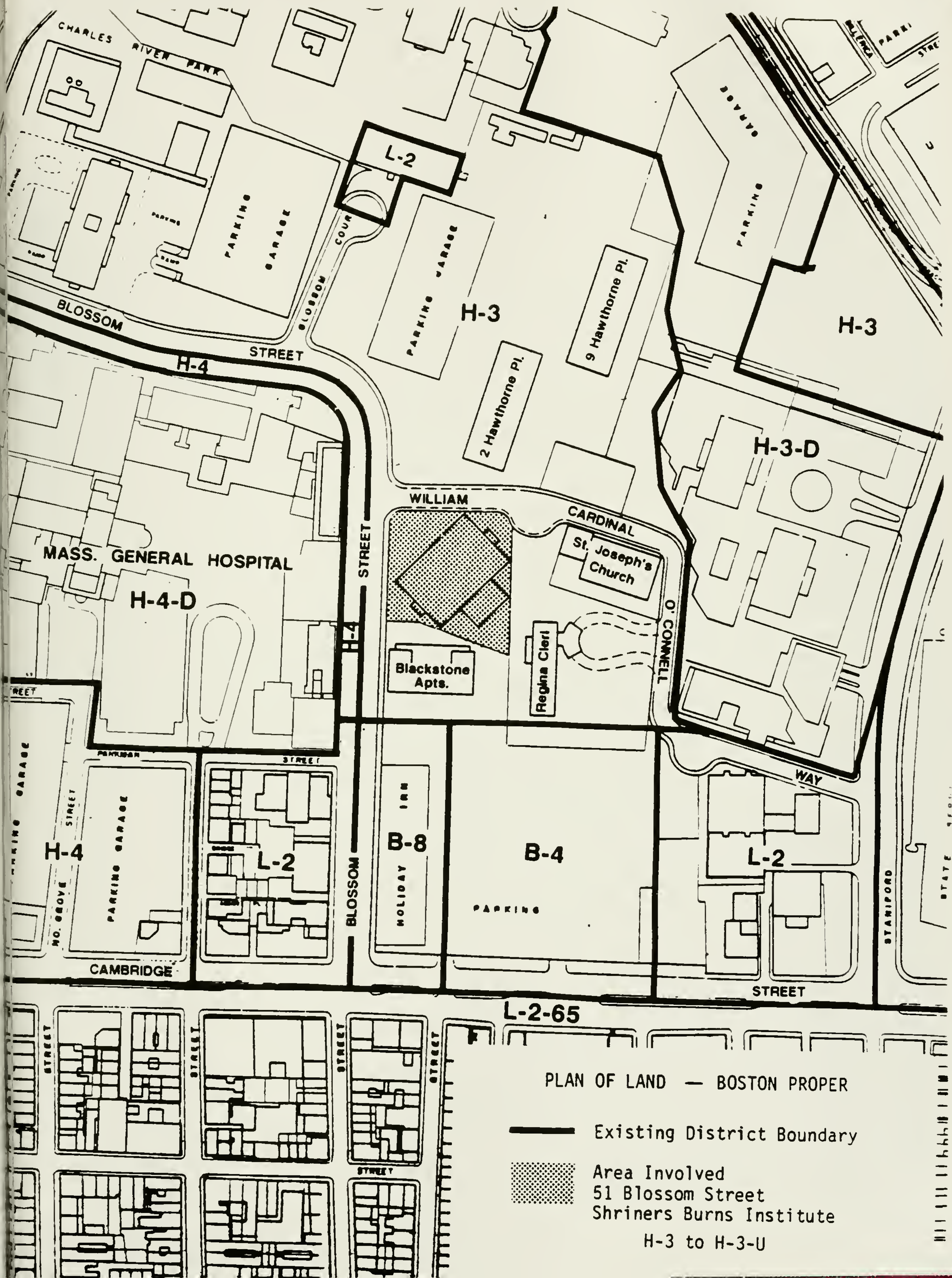
Map Amendment No. 281

Raymond L. Flynn
Mayor, City of Boston

Date: June 12, 1992

The foregoing amendment was presented to the Mayor on June 12, 1992, and was signed by him on June 12, 1992, whereupon it became effective on June 12, 1992, in accordance with the provisions of Section 3 of Chapter 665 of the Acts of 1956.

Attest: Marguerite Hildebrand
Secretary



PLAN OF LAND — BOSTON PROPER

▬ Existing District Boundary

▨ Area Involved
51 Blossom Street
Shriners Burns Institute
H-3 to H-3-U

3959 ,64

HMM ASSOCIATES, INC.
ENGINEERS, ENVIRONMENTAL CONSULTANTS & PLANNERS
A Summit Environmental Group Company

196 Baker Avenue
Concord, MA 01742
(508) 371-4000

Three Executive Par
Bedford, NH 03110
(603) 647-1010

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